JUNE, 1951

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION

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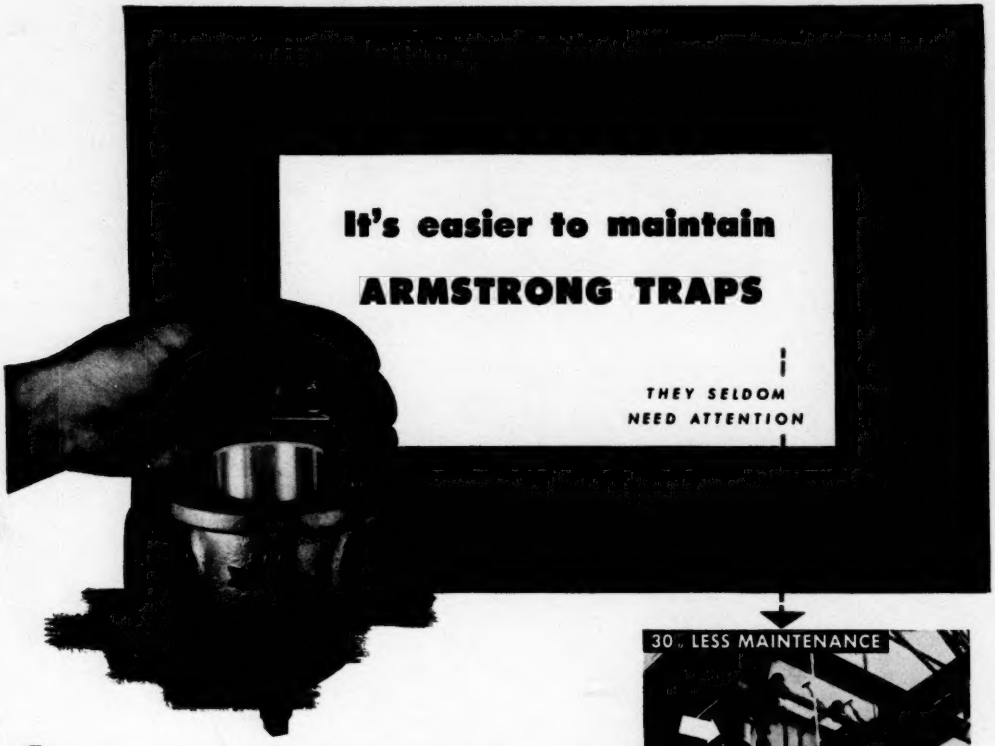
It's easier to maintain ARMSTRONG TRAPS

THEY SELDOM NEED ATTENTION



GOOD preventive maintenance of course calls for periodic steam trap inspection. To look inside an Armstrong trap you simply remove the cap and lift out the entire mechanism, which is connected to it. The body full of boiling water remains in the line and need not be handled.

Only rarely does inspection reveal the need for cleaning or repairing an Armstrong trap. The swirling action of the condensate during discharge continuously scrubs the trap clean. The hardened chrome steel valve and seat stay steam-tight for a long, long time without attention. There is no wire drawing. The leverage system is almost completely friction-free, will operate hundreds of thousands of times without wearing out.

For trouble-free trap performance there is nothing to compare with an Armstrong. Your local Armstrong representative can help you select the right size traps for your requirements. Call him.

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Armstrong traps on low pressure heating systems require far less maintenance than previous traps...John Deere Harvester Works, East Moline, Illinois.

"4 to 5 years service without replacement parts is average on traps draining driers. Some traps in service with no parts for 7 or 8 years—and one for 15 years!"—Weymouth Art Leather Co., South Braintree, Massachusetts.

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Saves money!

Saves critical materials!

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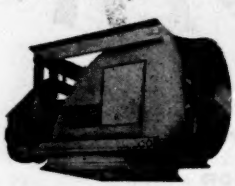
WINGFOIL SAFETY VENTILATING FAN

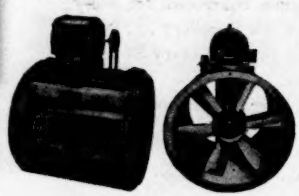
Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10" to 60" dia., with free air capacities from 825 to 59,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.



WINGFOIL DUCT FAN

(Elbow Type)

Designed to form an elbow in the duct system, the elbow-shaped housing in a strong rectangular frame permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10" to 60"; capacities up to 85,000 CFM.



WINGFOIL DUCT FAN

(Straight Line Type)

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.

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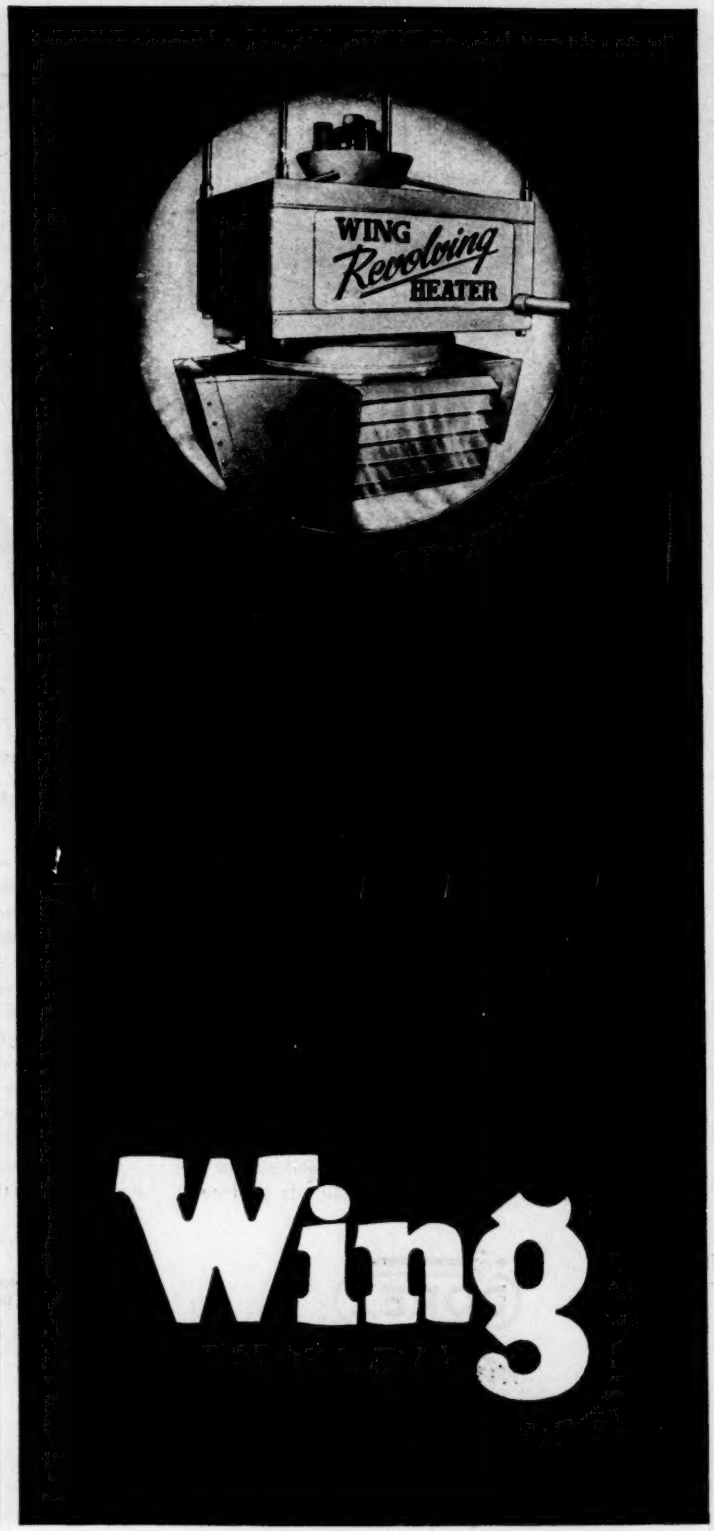

HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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CLIFFORD STROCK

Associate Editors
NATHAN N. WOLPERT
WILLIAM B. FOXHALL

Technical Consultant
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Advertising Staff

Chicago
GEORGE G. TURNER
228 North La Salle Street.

New York
HARRY J. TWINE
148 Lafayette Street.

Cleveland
EDWARD B. McENTEE
17115 Hillsboro Road.

Los Angeles
ROBERT H. DEIBLER
2506 W. 8th Street.

Published by

THE INDUSTRIAL PRESS
148 Lafayette Street
New York 13, N. Y.

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ROBERT B. LUCHARS

Vice-President and Treasurer
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Subscription Rates

Subscription rates in the United States and Canada, one year, $3; two years, $5; three years, $6; in all other countries, one year, $5; two years, $9. Single copies 30 cents. Entered as second-class matter, April 18, 1925, at the Post Office, New York, N. Y., under the act of March 3, 1879.

Member, Audit Bureau of Circulations.

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The Contents of HEATING AND VENTILATING are indexed monthly by Industrial Arts Index and by Engineering Index

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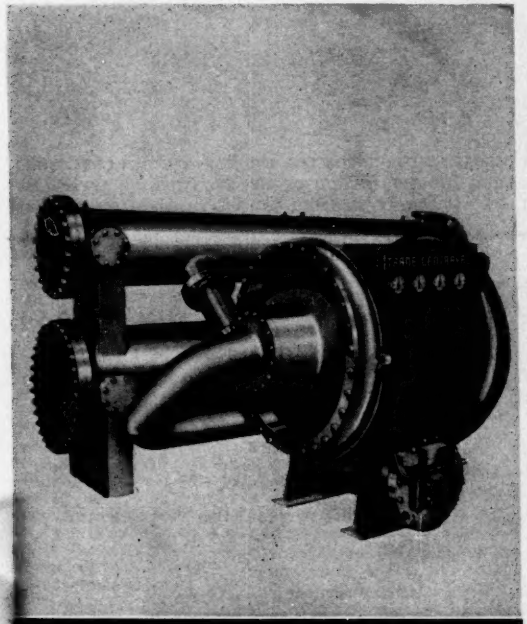
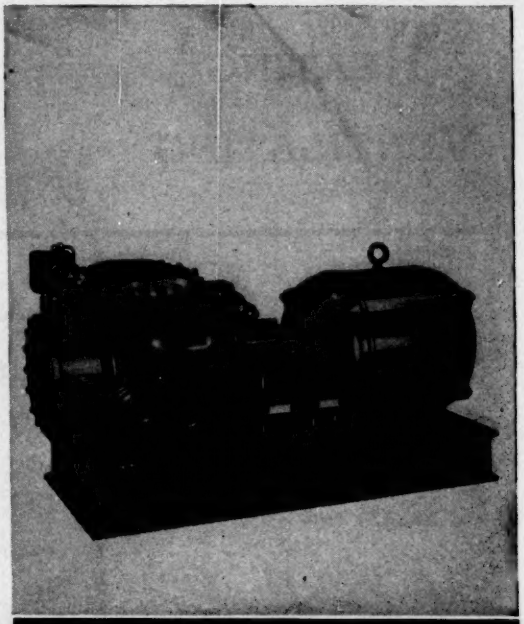
HEATING & PLUMBING EQUIPMENT NEWS
and technical books.

THIS MONTH'S COVER

These shirt finishing units are but one type of mechanical equipment found in commercial laundries. For design information concerning the power requirements of such machines and steam requirements for commercial laundries, see page 67. Photo courtesy, *Starchroom Laundry Journal.*



Trane CenTraVac—Hermetic Centrifugal Refrigerating Units. Six models starting at 45 tons



Trane Reciprocating Compressor and Condensing Units. Six models up to 50 tons in capacity

From Equipment Room to Penthouse

Many architects, engineers and contractors are discovering new advantages in the complete Trane line of heating, cooling and air conditioning equipment.

Trane manufactures equipment ranging all the way from a centrifugal compressor capable of developing more than 200 tons of refrigeration to a cooling coil small enough to carry under your arm. All the way from a tiny radiator valve to a 108" fan.

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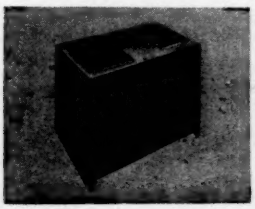
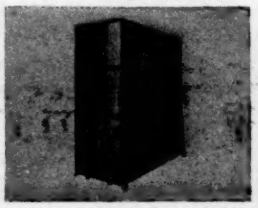
When Trane products are used together to provide air conditioning, heating and cooling for any type of building or for process, they offer:

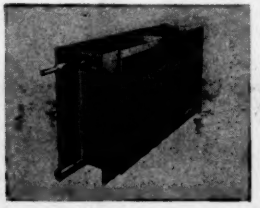
1. Undivided Responsibility—one manufacturer—Trane—assumes the complete responsibility for the correct rating and performance of all the equipment if properly installed and controlled—no blaming the maker of the evaporative condenser if the compressor won't work.



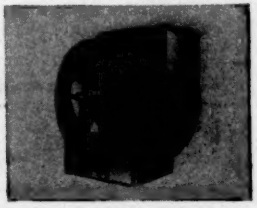
Trane Evaporative Condenser—For condensing refrigerants in the air conditioning system with the minimum use of water.



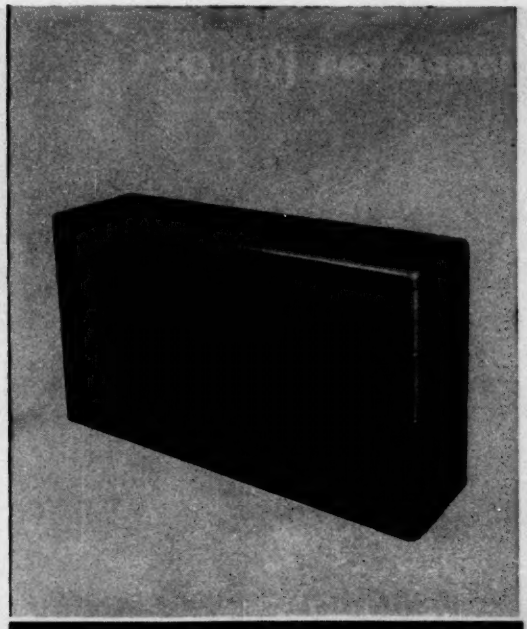
Trane Sprayed Coil Unit—For built-up systems requiring separate fan motor and drive and filters. Heats, cools and washes air.



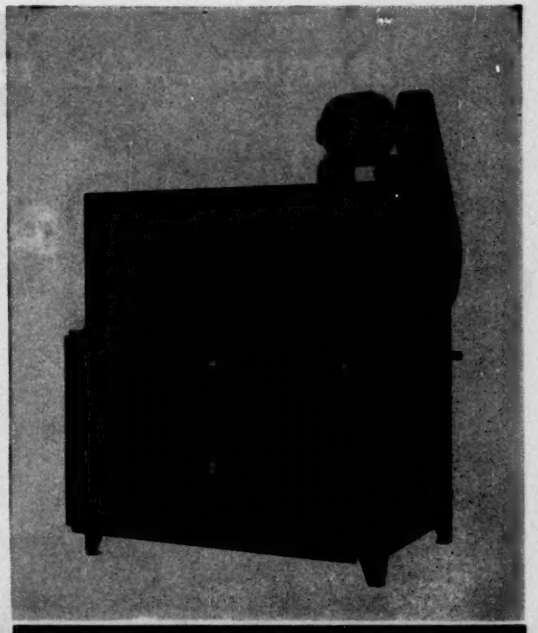
Trane Cooling Coils—For use with clean chilled water or well and municipal water or with direct expansion refrigerants.



Trane Centrifugal Fans—In Class I and II construction with backwardly inclined or forward curved wheel construction.



UniTrane Air Conditioners. Available in two styles with one, two or three fan arrangements.



Trane Climate Changers. Twenty four standard combinations of coils, fans, humidifiers, filters, dampers, 450 to 15,250 cfm.

Trane Air Conditioning Products Serve Everywhere

2. One Source of Supply—all products are sold by the same high-grade sales-engineers who are trained carefully as equipment consultants. They know Trane products and they know your problems of heating and air conditioning. You deal with one salesman instead of many.

3. One Set of Catalogs—you can select all the products you need for air conditioning from one catalog binder. No searching around for ratings and dimensions—no necessity for correlating ratings and sizes. Everything is contained in those big Trane binders that fit so handily at your elbow.

4. Complete Flexibility—all Trane products are available in a complete range of sizes and models. Regardless of your problems there is Trane equipment to fit your requirements exactly—no fitting your requirements to inflexible equipment. So flexible is the Trane line that you can create a 50-ton air conditioning system in at least 10 different ways.

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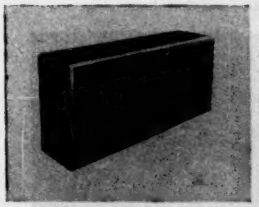
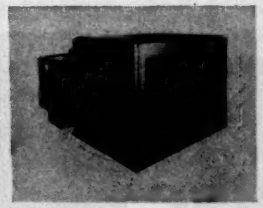
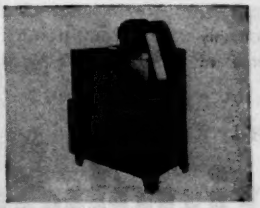
Whatever your air conditioning problem is, look for the answer in an undivided responsibility system of matched Trane products.



Trane Custom-Air—Deluxe air conditioning system for multiroom buildings. Controls temperature and humidity separately.



Trane Multi-Zone Climate Changers—A single air conditioner that handles up to six zones in the same building.



Trane AA Air Conditioner—A compact year-around unit for the small apartment, office, hotel or tourist court.

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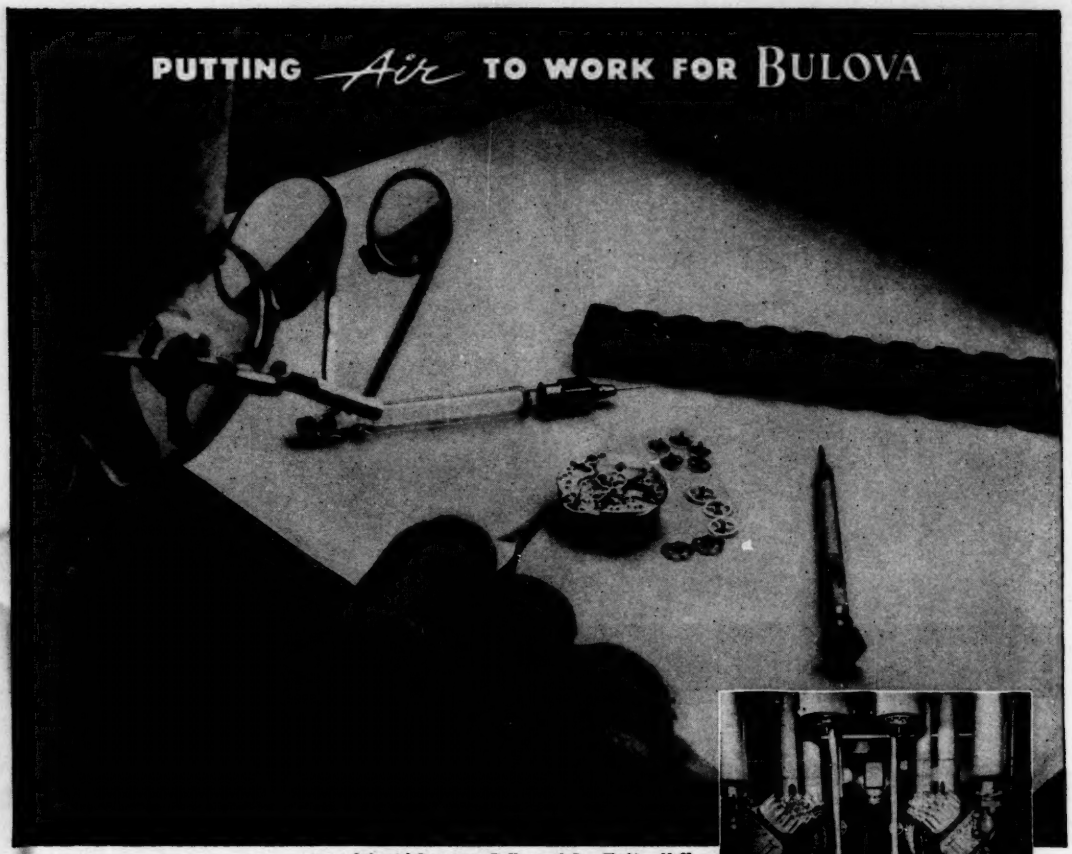

Industrial Contractor: P. Kretzer & Son, Flushing, N. Y.
Air Conditioning by: Abbott, Lester & Co., New York, N. Y.

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STREAMLINE wrought and cast fittings are available in a complete range of standard sizes.

See your jobber for further information or write for catalogs S-351 and W-251 describing our complete line of STREAMLINE wrought copper and cast bronze fittings.

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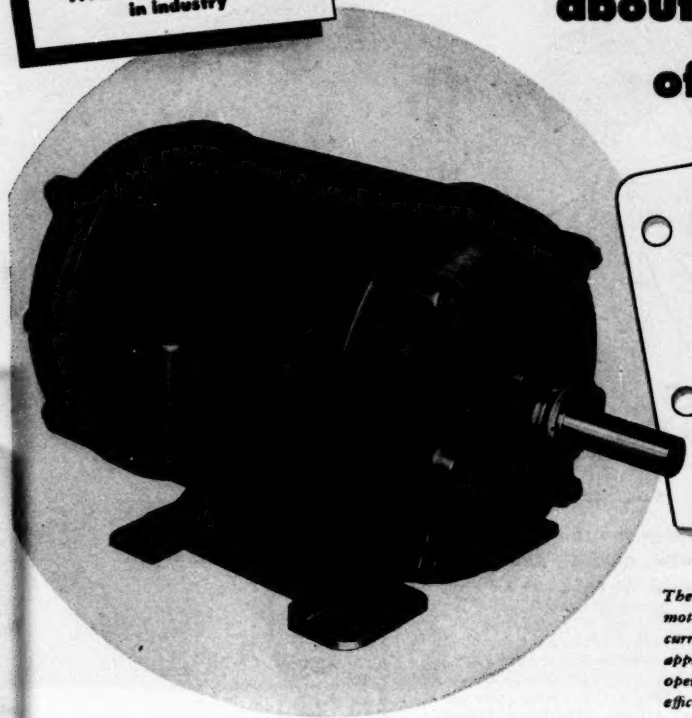

the Wagner type RA Motor offers the most simplified design to provide Repulsion-start... Induction Run

The Wagner Type RA Motor starts as a repulsion motor with high torque but with extremely low starting current and switches to an induction motor while approaching rated speed to assure a constant high operating speed, even under overload, and a flat efficiency curve over a wide operating range.

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1891 1951

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AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

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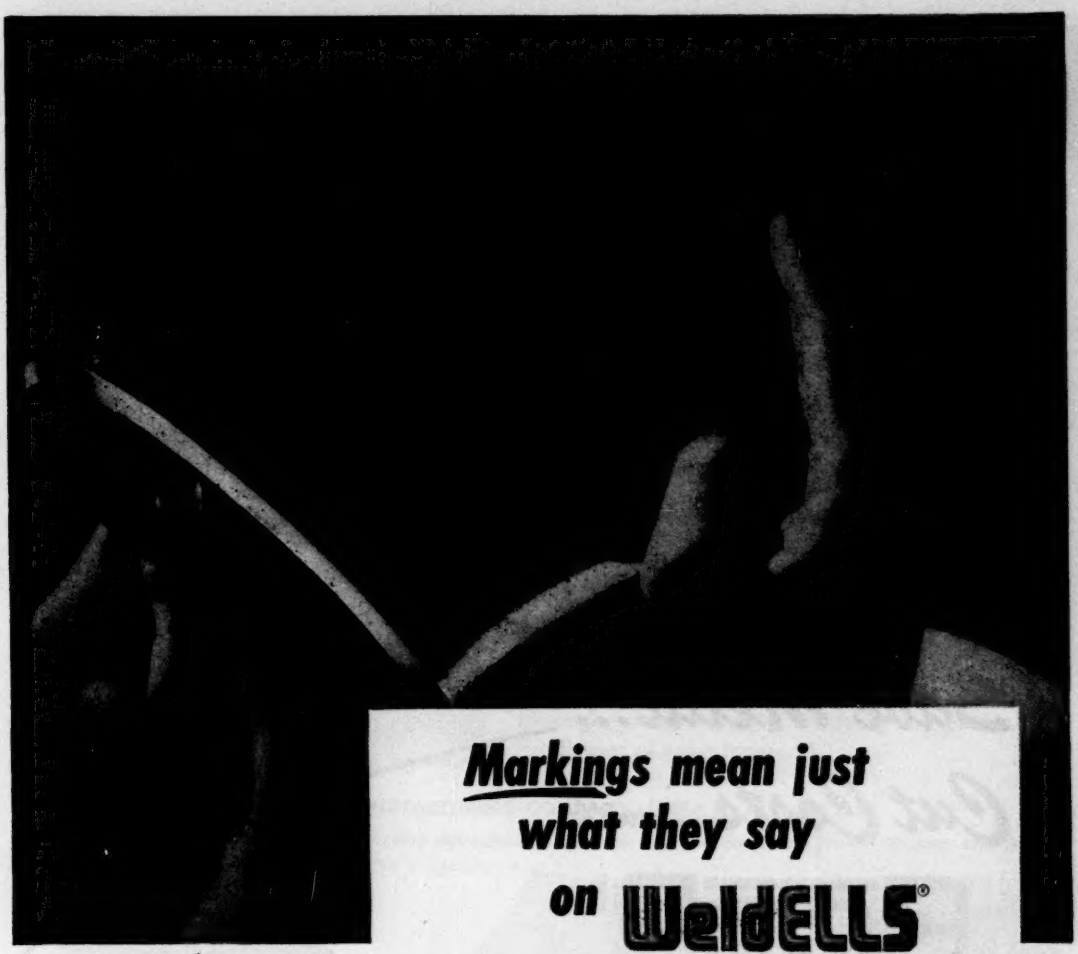

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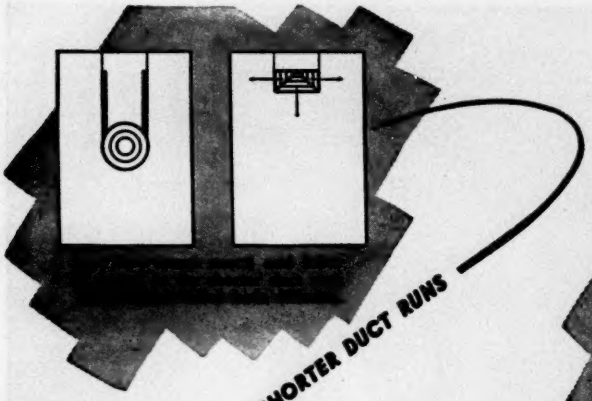
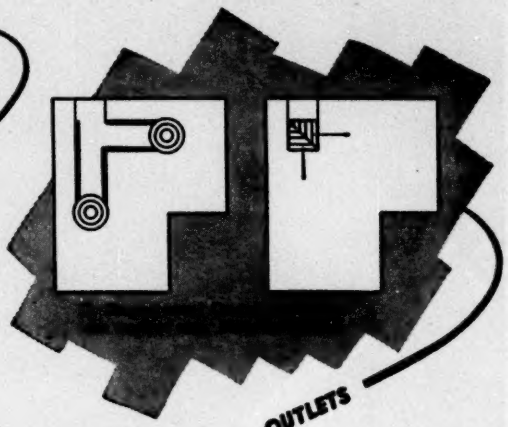


SHORTER DUCT RUNS



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CONSERVE CRITICAL MATERIALS

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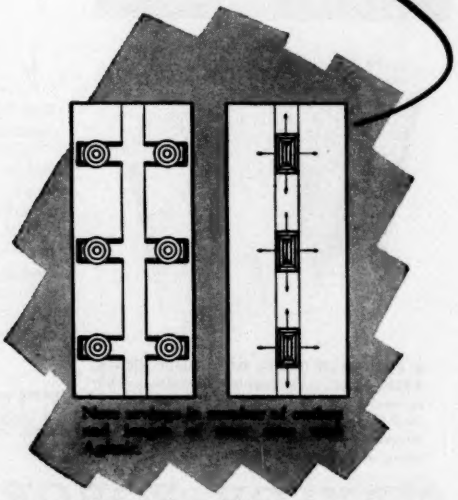

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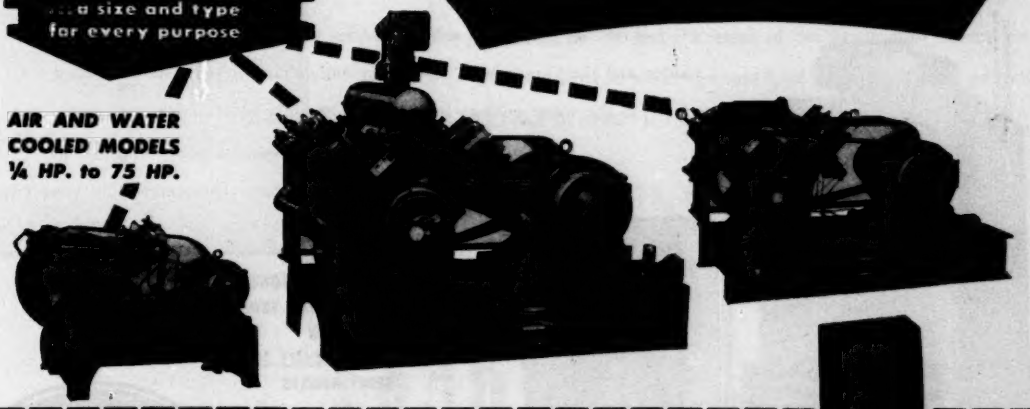
COOLED MODELS
¼ HP. to 75 HP.



BRUNNER
SINCE 1906

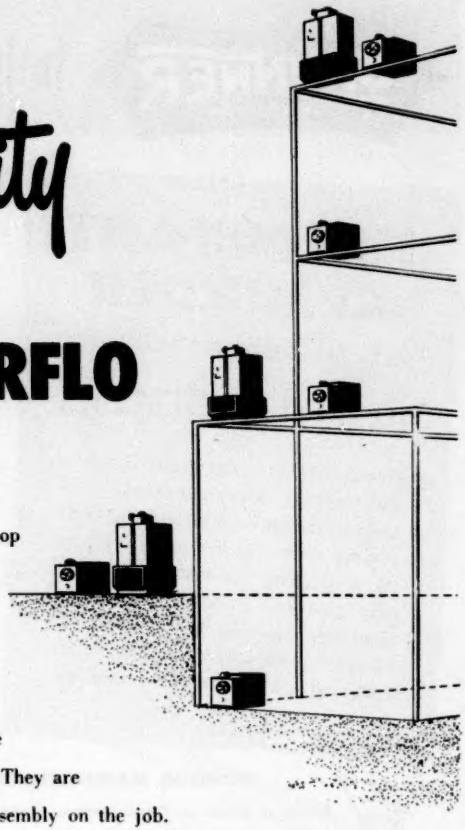
AIR CONDITIONING
Self Contained Units in 4 sizes: 3-5-7½ and 10 HP.
Remote Installation Types from 3 to 75 HP.

any location any capacity

Just name the place . . . and

AQUATOWER or VAIRFLO

will do the water cooling job!



Indoors or out . . . on the ground or on the roof . . . on the top floor or in the basement—*there's a Marley cooling tower designed to fit any location and any cooling requirement.*

If your job is in the 3-ton to 60-ton range, you need an adaptable Aquatower—the compact, trouble-free cooling tower for indoor or outdoor use. Aquatowers are made in nine sizes and two styles to do each specific job economically. They are shipped completely assembled or "knocked-down" for easy assembly on the job.

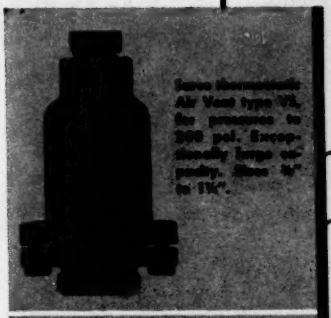
In larger capacity installations the answer is a versatile Marley Vairflo . . . a broad range cooling tower with all the quality "extras" ordinarily found only in heavy-duty, high priced towers. The Vairflo, in steel or wood, harmonizes with architectural design. All material in Vairflos is completely prefabricated for simple job erection.

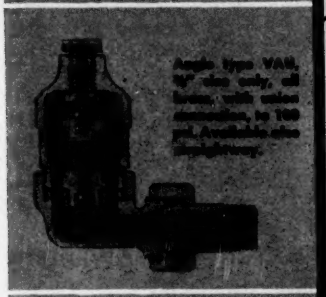
Whatever your need, select a Marley tower backed by the Marley guarantee and the "know-how" gained in more than 25 years of leadership in the water cooling industry. For more information, write for Marley bulletins AQ-51 and V-51, or call the Marley representative in your city.

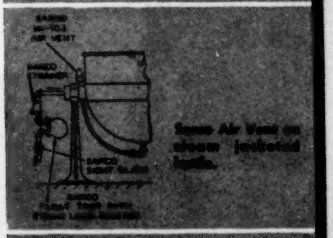
also producers of
DOUBLE-FLOW TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

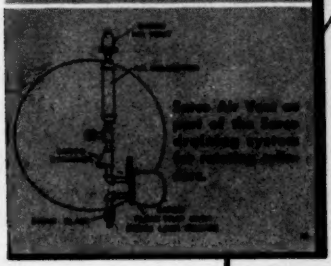
The Marley Company, Inc.
KANSAS CITY 15, KANSAS

MARLEY









air is expensive in the wrong place

Air is to be found everywhere – indoors, outdoors, above and below. It's difficult to think of it as expensive – it's so plentiful!

But air is to be found also in the steam spaces of your steam heated equipment. The air dissolved in the feed water supplied to your boilers finds its way into the heaters with the steam.

This air *is* expensive – because it reduces the temperature of the steam, and coats the heating surfaces with a film which retards heat transfer, lowers output, and increases losses.

Remove expensive air from your steam heated machines with SARCO THERMOSTATIC AIR VENTS, scientifically designed for this express purpose.

Write for BULLETIN 2751 and the name of the Sarco man nearest you. He will be glad to help you select the best type of vent for your purpose, and the right place to install it for best results.

SARCO ELIMINATES AIR

333

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
Represented in Principal Cities
SARCO CANADA LTD., TORONTO 5, ONTARIO

A Big Hit!

THE CHASE COPPER WATER TUBE CARTON

Now Chase Copper Water Tube comes in compact, sturdy cartons . . . easy to identify . . . easy to store.

In many sizes, the tubes are packed more than one coil to a box to reduce the carton disposal problem. And because it is clearly marked, you can pick your Chase Copper Water Tube Carton out of stock easily and quickly.

This is just another Chase service in line with the Chase tradition of providing the best in brass and copper.

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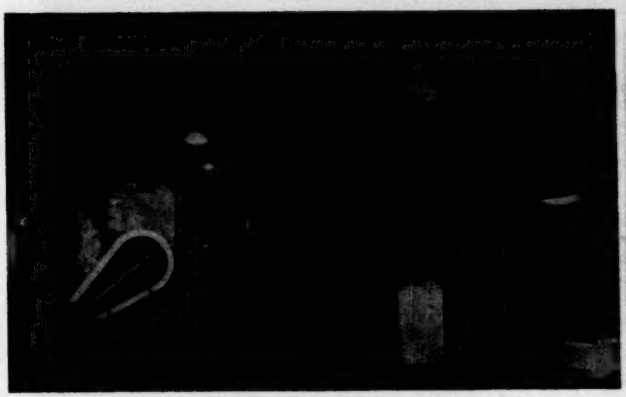
Air Conditioning HELPS TO GET 'EM Into the Air!

B-36D, Courtesy Consolidated Vultee Aircraft Corporation, whose Ft. Worth factory uses many Buffalo Air Conditioning Units.

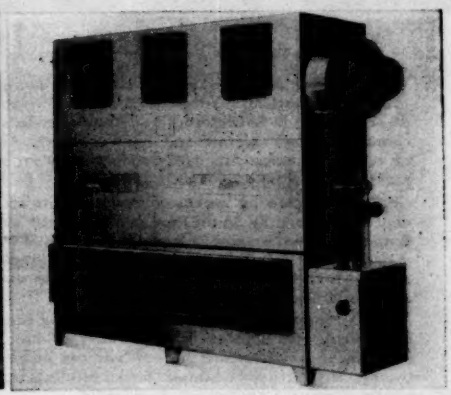
Modern warplanes are marvels of intricate mechanism—and conditioned air helps make them possible. The hundreds of designers, toolmakers and production workers who play a part in making a plane, do their work better because of conditioned air. Precision aircraft parts, such as instruments and optical and electronic equipment, were made under optimum atmospheric conditions. All textiles, such as the pilot's clothing, were made in atmosphere of exactly controlled humidity, temperature and dust content.

Every essential industry is putting air conditioning to work in *many* ways. And in every industry, you'll find "Buffalo" Air Conditioning Units doing their jobs well — air washing, heating, cooling, controlling humidity, ventilating. Their reputation for reliable performance, easy maintenance and long life comes from over fifty years in the business of air conditioning. Some of the original "Buffalo" Air Washers are still in active service.

FOR EXACT RESULTS, SPECIFY "Buffalo" AIR CONDITIONING UNITS



All-weather comfort conditioning is provided by this "Buffalo" unit, whose air supply is from the "Buffalo" Limit-Load Fan at left. WRITE FOR BULLETINS 3703 and 3181-B.



"Buffalo" Evaporative Coolers are ideal for cooling liquids for air conditioning, Diesel cooling, etc. WRITE FOR BULLETIN 3666.

FIRST FOR FANS

"Buffalo"

BUFFALO FORGE COMPANY

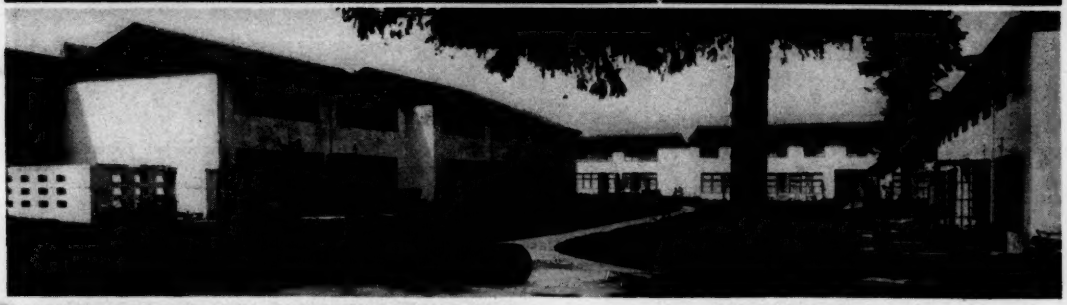
480 BROADWAY BUFFALO, NEW YORK

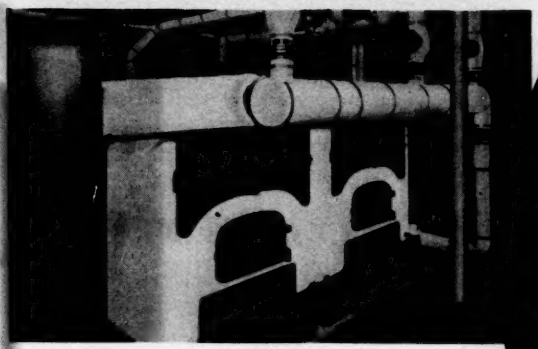
Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

AMERICAN-Standard

First in heating...first in plumbing





13 AMERICAN-Standard WATER TUBE BOILERS *heat 276 unit project*

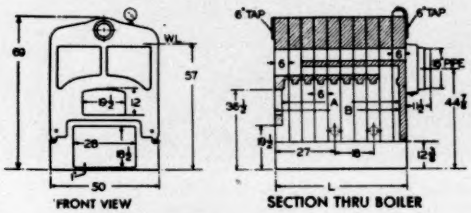
● One of the Northwest's finest court-type housing projects is Portland's attractive Binford. Privately owned by Mr. L. C. Binford, this 276 unit residential community is as modern as you'll find anywhere. And, of course, American-Standard products play an important role in keeping it so!

The entire heating system of this large project is dependably fired by 13 oil fired No. 36 Water Tube Boilers. Installed in most instances in batteries of two, they are doing an efficient, economical job of keeping all units in this many-family community snugly warm and comfortable.

The selection of American-Standard heating equipment for this development is just another example of the tremendous preference that exists among builders, owners, architects and engineers for all products bearing the famous American-Standard name.

These boilers and other top quality heating equipment by American-Standard are sold through selected wholesale distributors to heating and plumbing contractors. **American Radiator & Standard Sanitary Corporation,** P. O. Box 1226, Pittsburgh 30, Pa.

LOOK FOR THIS MARK OF MERIT



American-Standard Water Tube Boilers are made in a wide range of sizes so that, either single or in battery, they meet the heating requirements of any type of building. The diagrams above are front and sectional views of No. 36 Water Tube Boiler. In the sectional diagram, dimensions indicated are: (A)—from 29½" to 65½". (B)—32¾" to 68¾". (L)—36" to 72".

Serving home and industry

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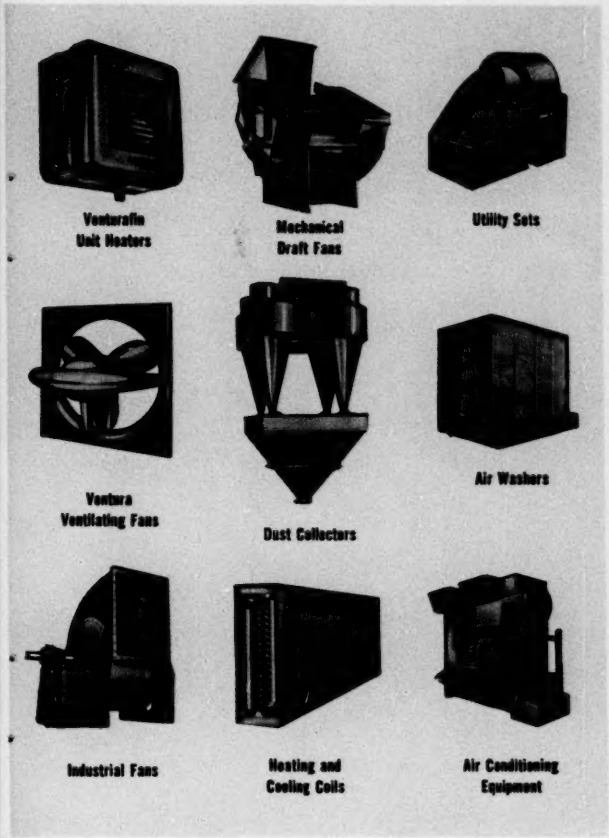
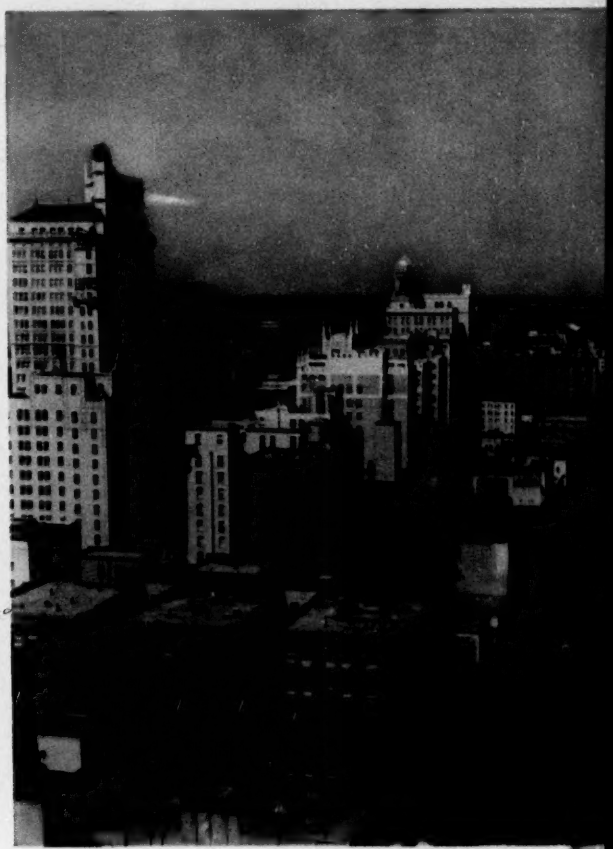
American Blower—a time-honored name in air handling

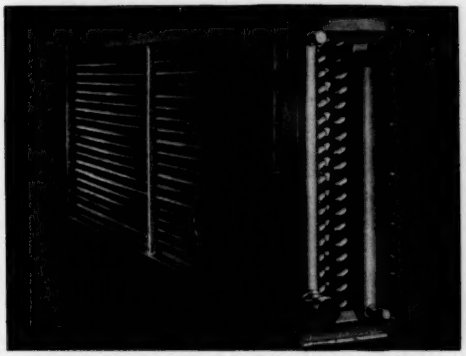




There's a big difference in quality, design, quietness, operating costs and efficiency between American Blower and ordinary air handling equipment. Compare! Look before you buy—and you'll buy American Blower products every time.

In Dallas, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Dallas area, call American Blower—Central 5518. In other areas, consult your phone book.

Product of the month



American Blower Cooling Coils are available in a wide range of tube faces, lengths, coil depths and fin spacings.

Order American Blower Cooling Coils now

American Blower Cooling Coils are specially designed for use in air conditioning systems, industrial process work and dehumidifying applications.

Three types are available: (1) *Type W Water Coils* for all normal cooling and dehumidifying requirements using refrigerated or naturally cold water; (2) *Type C Cleanable Water Coils*, fitted with cleanout plugs for use where water used tends to deposit solids in tubes and headers; (3) *Type X Direct Expansion Coils*, for use with direct expanded refrigerants. All are made in many shapes and sizes, giving a wide range of capacities.

With American Blower Cooling Coils, famous for built-in quality, you are assured of years of dependable service. Investigate now. Contact your nearest American Blower Branch Office for data.

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CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

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Serving home and industry

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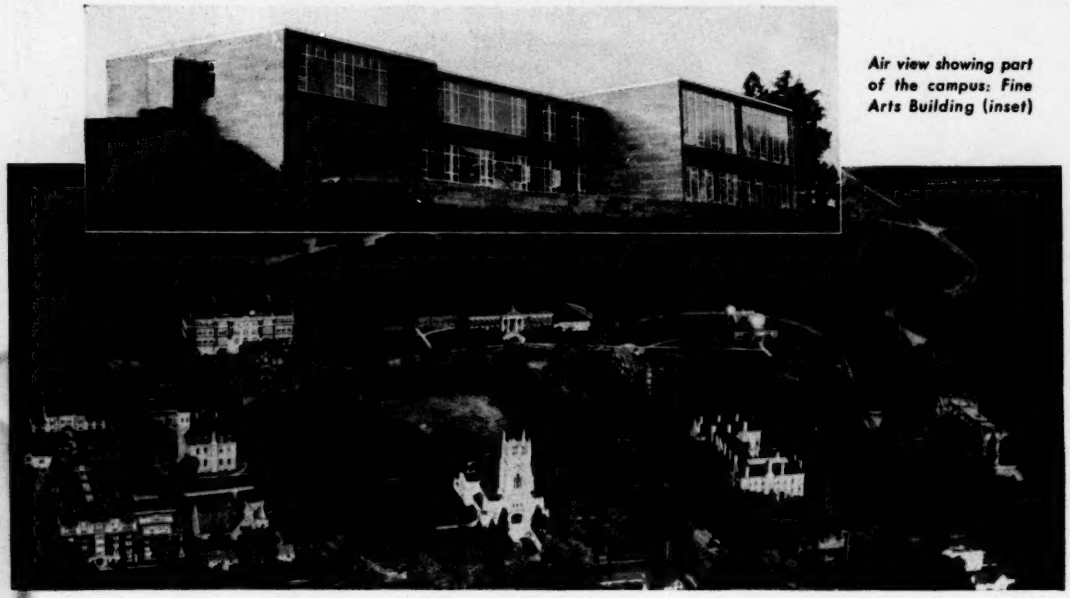
ILLINOIS *Heating Systems*

in CARLETON COLLEGE, Northfield, Minnesota



Air view showing part of the campus: Fine Arts Building (inset)

FINE ARTS BUILDING, CARLETON COLLEGE

MAGNEY, TUSLER & SETTER, ***Architects and Engineers***

GRASTVEDT PLUMBING & HEATING COMPANY, ***Heating Contractors***

This famous and typically American college, founded in 1866, is located forty miles South of the Twin Cities. The buildings throughout the campus are supplied with steam from a central power plant (at extreme left). Several of the buildings, such as Gridley Hall, Freshman Girls' Dormitory, and others, are equipped with ILLINOIS Zone Control Valves and low pressure steam specialties.

The new Fine Arts Building, modern in design and up-to-the-minute in mechanical equipment, is the latest unit to be added to this notable group. ILLINOIS valves and traps are also used in this building.

Illinois Heating Systems found in America's finest buildings assure the utmost in fuel economy, heating comfort and convenience of operation.

Minnesota Representative

THE MECHANICAL SERVICE COMPANY, 809 PENCE BUILDING, MINNEAPOLIS 3.

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ILLINOIS ENGINEERING COMPANY

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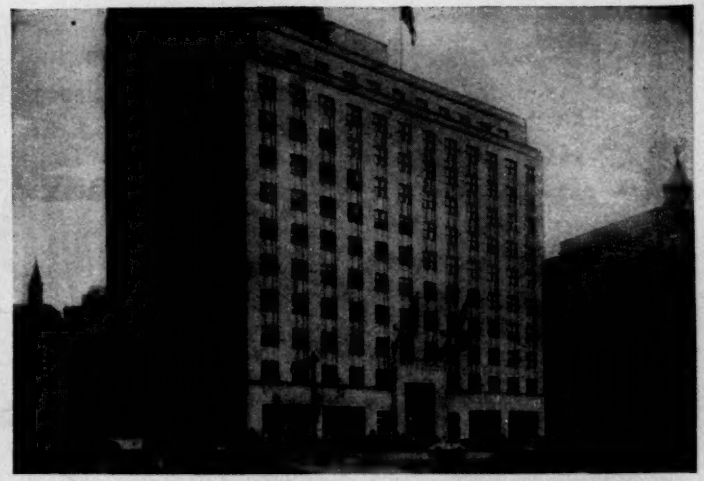
RACINE AVENUE AT 21ST STREET • CHICAGO 8

AIR CONDITIONING SYSTEMS *for* BUSINESS AND INDUSTRY

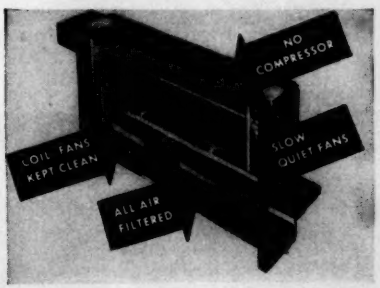


NEW DUN & BRADSTREET BUILDING in New York City has G-E Personal Weather Control Air Conditioning. Over 450 G-E room units circulate filtered, fresh air that is cool in summer, warm in winter. Architect: Reinhard, Hofmeister, & Walquist. Consulting engineer: Syska & Hennessy, Inc. General contractor: George A. Fuller Company. Air conditioning contractor: Kerby Saunders, Inc.

Cut first cost...and save in the long run, too, with

G-E PERSONAL WEATHER CONTROL

NO COMPRESSOR IN ROOM UNITS, just quiet, velvet-smooth fans and G-E motor. Room occupants can set temperature as they like without disturbing others. Units are supplied with attractive cabinets (above) or can be concealed in walls. Windows are never blocked.



ALL AIR FILTERED, protecting coils from dust which cuts performance drastically. Filters — inexpensive, changed in less than a minute—reduce room cleaning, avoid costly coil cleaning. Nine-inch deep unit takes little space, circulates air gently through large area.

HERE IS an air conditioning system that in most cases costs less to install...and goes on piling up savings for its owner through many years of operation.

It's General Electric Personal Weather Control, which heats in winter and cools in summer...utilizing individual G-E room air conditioners supplied with hot or chilled water through simple pipe runs from a central heating and refrigeration plant.

HOW YOU SAVE...Valuable space can be saved and alterations can be avoided by supplying ventilation through small-size ducts, the method used in the new Dun & Bradstreet Building (above) in New York City. Installation costs can be reduced even further by installing these systems with no ducts at all...using wall apertures for fresh air.

G-E Personal Weather Control often requires substantially less compressor capacity, saving both installed and operating cost. When rooms are unoccupied, units can be shut off. When there are few people in the building or the system is being started in the morning, units can be operated without the expense of running ventilation equipment.

MAKES YOUR BUILDING MORE PROFITABLE...Tenants enjoy living or working in buildings air conditioned by G-E Personal Weather Control. Each tenant can set the temperature of his room without disturbing others. And it's easier to rearrange office space, because G-E room units are flexible.

It's no wonder that G-E Personal Weather Control Air Conditioning is installed in Houston's Sterling Building ...12 Sheraton Hotels...the prominent new 575 Madison Avenue Building in New York City...and other leading buildings all over the United States.

GENERAL ELECTRIC

FREE DATA to architects, engineers, builders, contractors, and building owners.

General Electric Company, Air Conditioning Dept., Sec. HV-9, Bloomfield, N. J.

Please send me, without obligation, detailed information on G-E Personal Weather Control Air Conditioning.

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COMPANY.....

ADDRESS.....

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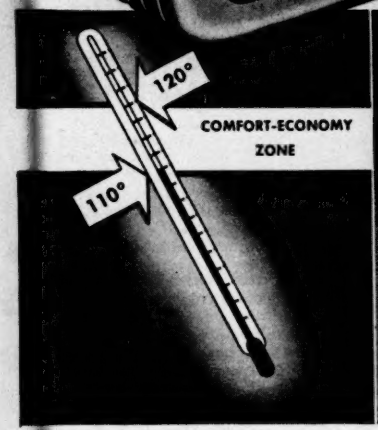
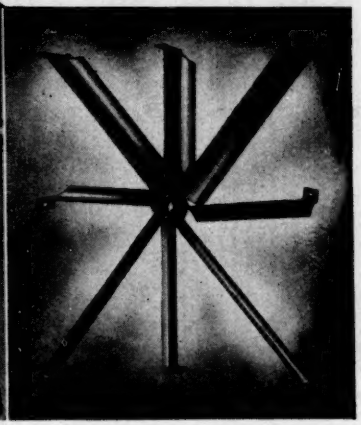
Engineers Rate Modine the
Standard of Excellence

COMPARE FIRST...

...YOU'LL CHOOSE

MODINE UNIT HEATERS





Discharge air temperatures of 110°-120° F. . . . correctly related to air velocities assure perfect heating comfort, lower fuel costs.

Direct-from-pipe suspension is safe and economical. Heated air stream may be easily re-directed over full 360° range.

Built-in velocity generator effectively steps up heat-throw, permitting positive penetration of cold air strata near floor.

Three of many outstanding features which account for the Modine quality reputation

Whether you choose Modine *Horizontal, Vertical* or *Power-Throw* Unit Heaters you are assured of unequaled heating performance — high fuel economy — low operating and maintenance costs . . . for years and years. Beautifully styled — yes! But it's the advanced engineering design features, highest grade materials and workmanship that account for this famous Modine built-in quality. No wonder engineers rate Modine the standard of excellence among unit heaters. *Yes, compare first . . . and you too will choose Modines.* Modine Manufacturing Co., 1511 Dekoven Ave., Racine, Wisconsin.

Ask for Modine Unit Heater Bulletin 149A. Also available — bulletins covering special applications in commercial brooder houses, greenhouses, milk houses and many other applications.

Modine UNIT HEATERS

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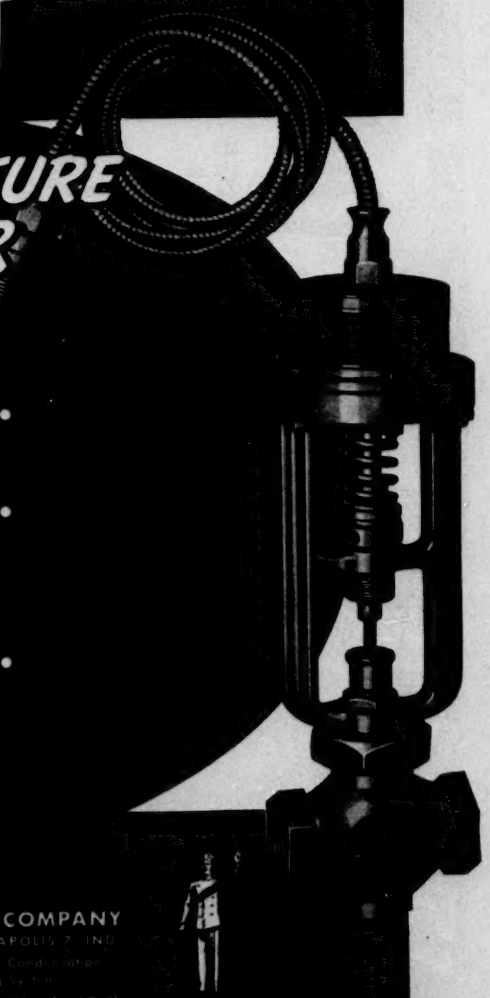
PRESSURE REDUCING VALVES

TEMPERATURE REGULATOR



Made of Brass in ¾", ¾", 1", 1¼", and 1½" sizes.

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HOW TO choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

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which saves time and effort in selecting valves for common piping services.

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QUIETER, CLEANER, SAFER, with
SUPERIOR'S Built-in, INDUCED Draft.

Superior's Induced Draft prevents the escape of combustion gases into the boiler room — even through an open port. For our photo shows one of our engineers observing the fire through the wide open pressure-relief port.

It also explains one other distinct advantage of induced draft — the fact that the fire is pulled through each successive pass without impingement and wear on refractory as is the case under forced draft. For that relief port is at the end of the first pass where the combustion gases are turning the corner into the second pass. If they weren't being led, some of them would find their way out through the open port.

Greater quiet, longer trouble-free operation, cleaner, more healthful atmospheres are other primary results. We can't tell you the whole story here, but you'll find it all in our new catalog. Write today to reserve your copy of the newest edition. Ask for Catalog 319.

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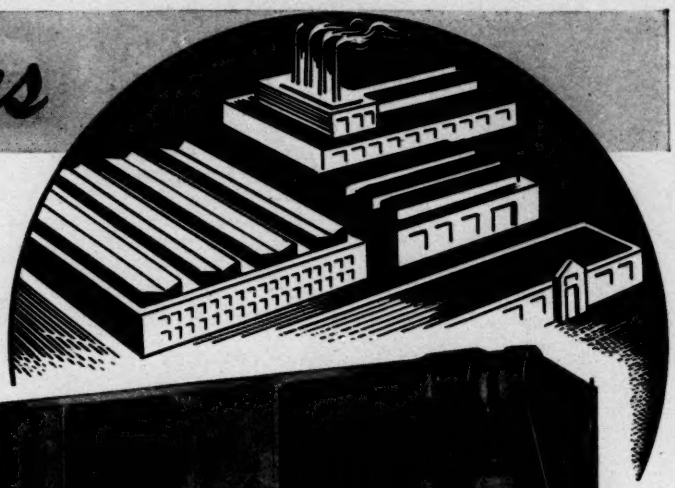
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N. Y.

SUPERIOR
STEAM GENERATORS

13 Sizes



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Coil Face Areas From 1.1 to 32.9 SQ. FT.

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KENNARD *Engineered* **AIR CONDITIONING BLOWER UNITS**
Heating and/or Cooling

Available with—face and by-pass dampers, humidifiers, mixing boxes with dampers, etc. . . .

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ANOTHER NOTABLE ACHIEVEMENT IN SERVICE LITERATURE BY JENKINS

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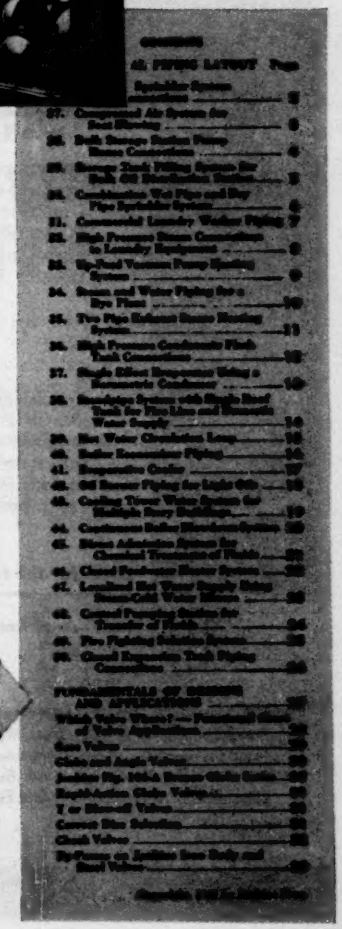
practical piping layouts



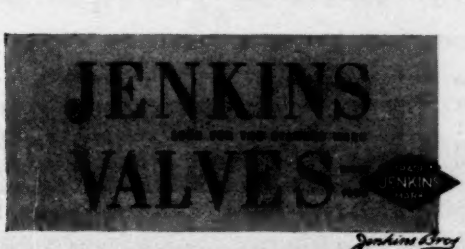
The second series of twenty-five basic Piping Layouts (published by Jenkins Bros. in leading industrial, professional, and engineering publications) is now available in booklet form.

If you are among the hundreds of valve-users who received a copy of the first book, or if you saved any of the fifty Jenkins Piping Layouts as they appeared, then you know how helpful this information can be in planning any valve installations.

This new book brings you not only 25 practical piping layouts, arranged in convenient form for quick reference. It also includes a section on the fundamentals of valve design and application to help you select the type of valves best suited for the service.

Use it as a guide to proper valve selection and placement for longest service life and lowest operating costs. Use it also for an introduction to the wide range of Jenkins Valves for every industrial engineering and plumbing-heating service. You can obtain a copy by requesting it on your business letterhead. Address:

Dept. H, Jenkins Bros., 100 Park Ave., New York 17, N. Y.



Sold through leading industrial distributors everywhere

THIS SECTION
DOUBLES ITS
VALUE TO YOU

Tells "Which valve where, and why"—with information in chart form for quick reference. A compact manual that will be prized by everyone, beginner and veteran alike, who plans piping.

4 Important Catalogs to help you select HEAT EXCHANGE EQUIPMENT

Catalogs contain complete information for quick selection of rating and capacities — with designs and installation charts.

p-k Hot Water Storage Heaters and Preheaters

Standard construction details, storage and heating capacities, dimension tables, A.S.M.E. and standard specifications. Vertical units for heater service and Lo Flo boiler water heaters are also described. Typical hot water consumption figures for various types of building application are included.

Catalog No. 17 (20 pp.)

p-k Hot Water Convertors

An aid in the selection of the proper convertor for hot water heating systems. Contains dimension and capacity tables for 2- and 4-pass units for installation in standard and radiant heating systems—for steam pressures from 0 to 15 psi. and water temperatures from 90° to 220° F.

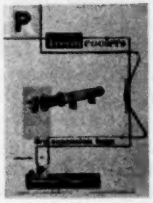
Catalog No. 303 (8 pp.)

p-k Instantaneous Heaters and Heat Exchangers

Selection data on 2-, 4-, and 6-pass "U" tube hot water heaters—capacities from 95 to 101,000 gph.—steam pressures from 0 to 100 psig.—water temperatures from 40° to 100° F. inlet and from 80° to 300° F. outlet. Also covers pressure drops, capacities and dimensions for Condensate Coolers, and Booster Heaters. Typical piping arrangements are shown.

Catalog No. 202 (40 pp.—tab indexed)

p-k Freon Coolers (Water)



For selecting Freon coolers for air conditioning, refrigeration, industrial or process cooling applications. Cooling surface required for capacities from 2 to 232 tons of refrigeration at water flow rates from 7½ to 862 gpm. for 1- and 2-circuit coolers are tabulated. Dimensions, pressure drops and typical piping arrangements are included.

Catalog No. 101 (12 pp.)

Write for the catalog that concerns your heat exchange problem. There is no obligation.

p-k *70 years of heat transfer experience assures you of superior design and construction*

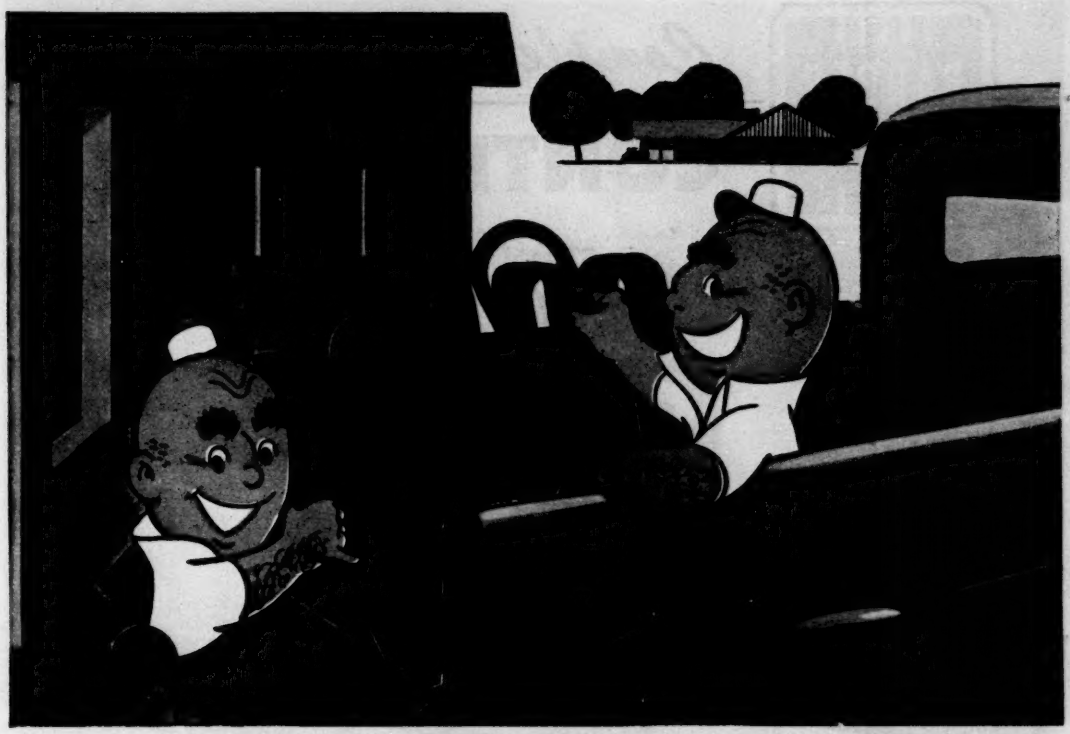
Dry Expansion Freon Coolers • Freon Condensers • Flooded Type Freon Coolers • Instantaneous Water Heaters • Suction Line Heat Exchangers • Ammonia Coolers • Ammonia Condensers • Storage Water Coolers • p-k Balance Loaders* • p-k Slug Eliminators* • Allied Shell and Tube Heat Exchanger Equipment

* Patented

the Patterson-Kelley Co. Inc.

87 Burson Street, East Stroudsburg, Pa.

101 Park Avenue, New York 17 — Railway Exchange Building, Chicago 4 — 1700 Walnut Street, Philadelphia 3 — 90-A Huntington Avenue, Boston 16



Better radiant heating systems start with Bundyweld Tubing

Bundyweld Tubing performs better in your systems, cuts waste, saves time in fabrication, too.

It stands alone, the only tubing double-walled from a single strip, with an exclusive beveled seam-edge. It's copper-brazed through 360° of wall contact into a smoother, stronger, solid-wall tube that spells leakproof, efficient radiant heating systems right from the start.

Bundyweld comes to you in twenty-foot lengths with one end expanded if specified. It fabricates quickly, easily at your shop or building site. No kid-glove handling; it's ductile, yet extra-strong. One man easily forms Bundyweld on a simple bending fixture. Just two men quickly position the lightweight, rigid grids.

Check your *Sweet's Architectural File* or write us now for more detailed information. Though defense tubing requirements get first call, we'll do our best to fill your needs. ***Bundy Tubing Company, Detroit 14, Michigan.***

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any leakage.

BARBER COLMAN

Complete CONTROLS *for*

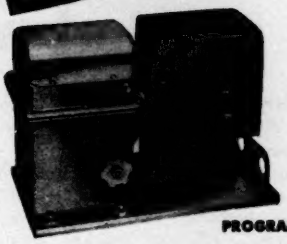
✓SINGLE-STAGE ✓TWO-STAGE ✓MULTIPLE-STAGE

COOLING *Systems*

REMOTE BULB THERMOSTAT

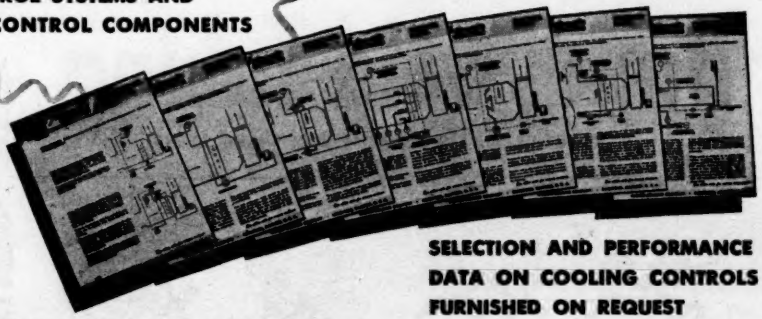
SINGLE-STAGE ROOM THERMOSTAT

TWO-STAGE ROOM THERMOSTAT



PROGRAM SWITCH

COMPETENT FACTORY-TRAINED FIELD ENGINEERS ARE AVAILABLE FOR ASSISTANCE IN THE DESIGN OF COOLING CONTROL SYSTEMS AND THE SELECTION OF CONTROL COMPONENTS

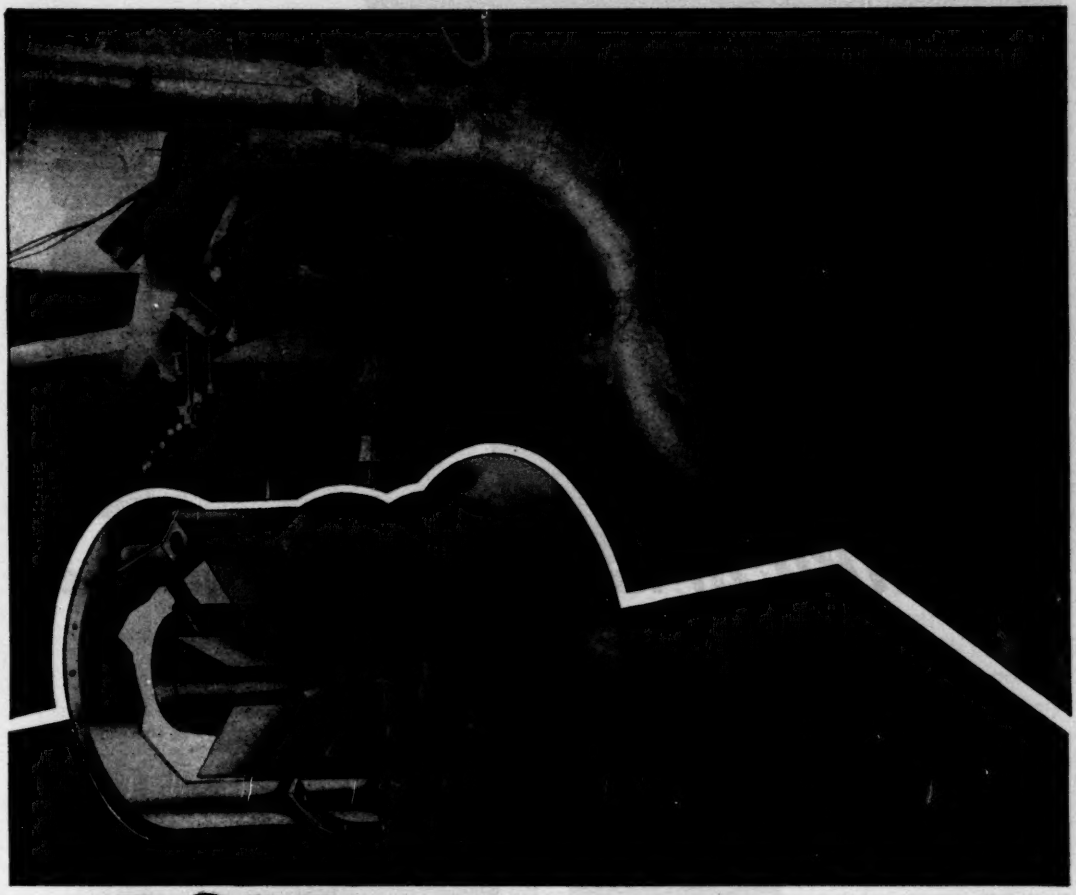


SELECTION AND PERFORMANCE DATA ON COOLING CONTROLS FURNISHED ON REQUEST

BARBER COLMAN

BARBER-COLMAN COMPANY

1224 ROCK STREET • ROCKFORD, ILLINOIS



JOY AXIVANE* FANS

(SERIES 1000)

Write for Bulletin, or

Consult a Joy Engineer

The quieter operation, lighter, more compact design, lower power consumption and unmatched efficiency of JOY Axivane Fans are *real* advantages! What's more, their vaneaxial design and in-line construction permit mounting right in the air duct, making installation simple and saving greatly on time and cost. These features, plus the extreme flexibility of operating range made possible by adjustable blades—a standard feature of all JOY Fans—mean better, more dependable and lower-cost ventilation, no matter what your conditions are.

● Let JOY Axivane Fan specialists work with you for best results on your ventilation jobs.

*Reg. U. S. Pat. Off.

WBD 12355

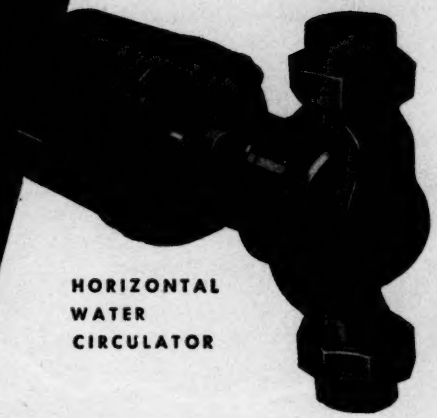
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

you can offer your customers

Radiant Heat

IN ALL THE NEW MODERN METHODS



HORIZONTAL WATER CIRCULATOR

with *THRUSH* forced circulating hot water heat

HEATING METHODS are on the march! Forced Circulating Hot Water Heat, which offers the mildest and most uniform heating, also permits the use of many new and modern heating methods not possible with other forms of heating. It is ideal for radiant heating in any form.

Thrush System gives precise control of temperature for hot water heating, completely eliminates wasteful overheating and assures that continuous feeling of well-being due to the constant presence of radiant heat.

RADIANT CEILING PANELS

Thrush Controls are economical, in both installation and operating costs.

RADIANT FLOOR PANELS

Thrush Controls provide continuous warmth with economical Circulator operation.

RADIANT BASEBOARD

Thrush Controls maintain comfort, compensate for outdoor weather changes.

RADIATORS · CONVECTORS

Uniform Heat is always present with Thrush Flow Control System on the job.

ZONE CONTROL

Inexpensive zoning with a Circulator, Flow Valve, and No. 201 Control for each zone.

NO. 201 RADIANT HEAT CONTROL WITH RELAY TRANSFORMER

VERTICAL FLOW CONTROL VALVE WITH AIR TUBE

Ask your wholesaler or write dept. D-6

H. A. THRUSH & COMPANY

PERU · INDIANA

Tri-Flex Aerovane

in 525 William Penn Place Building

Pittsburgh, Pennsylvania

Architects, engineers, contractors — planners and builders of tomorrow — choose their materials with care. The quality of the completed job depends on them. And the specialists responsible for the successful, dependable operation of an air conditioning system pay strict heed to the proper selection of the air distribution equipment... *the point where success is measured.*

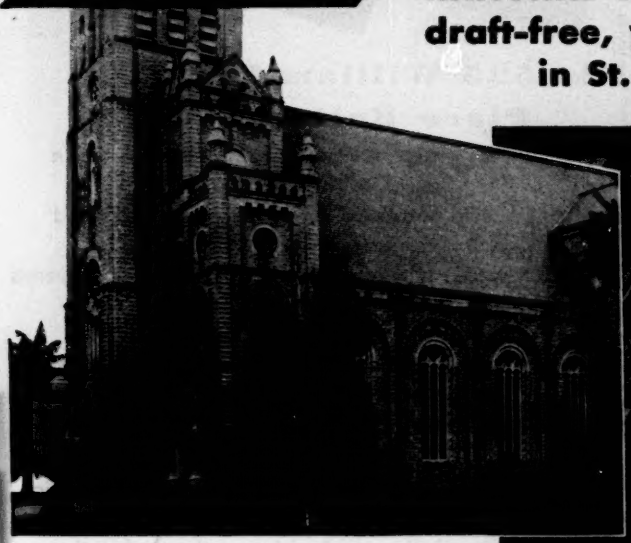
In the 525 William Penn Place Building — as in important buildings from coast to coast — the choice was the outstanding combination of Tri-Flex and Aerovane Grilles and Registers... the combination that insures maximum flexible control of air delivery ... meets the most exacting requirements of performance. For consistent quality that guarantees the results, standardize on Tri-Flex and Aerovane. For complete information, write for Catalog 48S.

TUTTLE & BAILEY inc

NEW BRITAIN, CONNECTICUT

ENGINEERED PRODUCTS FOR HEATING, AIR CONDITIONING AND VENTILATING

NOW . . . modern radiant heating with NATIONAL STEEL PIPE assures draft-free, year-round comfort in St. John's Church



ST. JOHN'S CHURCH in Delphos, Ohio, is a good example of a hard-to-heat building made comfortable with radiant heating.

The auditorium in this beautiful old stone church is 135′ x 65′. The vaulted ceiling is over 65′ high. Here was a natural for radiant heating.

To keep installation costs down, the insulating paper was laid right over the old wood floor. Then came ¾″ steel bars. Finally, 10,110 feet of 1¼″ National Steel Pipe was tied to the bars and over this a 2″ layer of concrete was poured.

Now, at last, the floors are warm. The entire auditorium is comfortable. And the room is free from obstructions, hot spots and cold spots.

Why did they use National *Steel* Pipe? For one thing, it's economical in cost . . . it is readily welded, it is strong, yet sufficiently ductile to permit easy bending. But best of all is its record for long life and trouble-free service. It has been standard for conventional hot water heating for over 60 years.

If you are planning a future radiant heating installation for a church, garage, store, terminal, factory, warehouse or plant, remember that National—the world's largest selling pipe—has all the qualities that make for a successful application.

USS

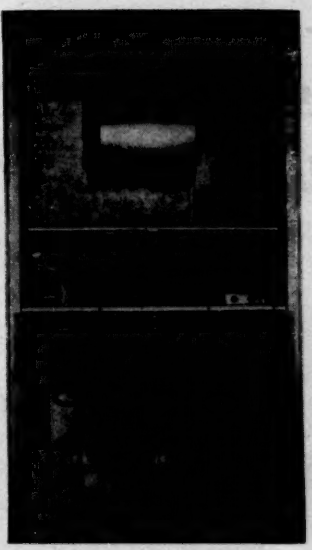
NATIONAL TUBE COMPANY, PITTSBURGH, PA.

COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL Steel PIPE

UNITED STATES STEEL

EVERYTHING YOUR CUSTOMER WANTS



IN A PACKAGE AIR CONDITIONER

Here are the reasons why your customer will be happy with his Worthington Package Air Conditioner:

QUIET—acoustically insulated cabinet . . . no belts to wear or get out of line.

VIBRATION-LESS—smooth-floating multi-mounted compressor . . . dynamically-balanced fan.

TROUBLE-FREE—compressor hermetically-sealed against dust and moisture . . . no pulleys, couplings or seals.

NO ATTENTION NEEDED—pressure-type oiling . . . never needs replenishing.

LONG LIFE—compressor surfaces finished to micro-inch accuracy . . . oversize bearings . . . four rings per piston . . . dynamically-balanced crankshaft.

SAFE—high-pressure cut-out . . . high temperature safety switch.

CONVENIENT—finger-tip selection of temperature . . . thermostatic control . . . finger-tip adjustment of louvres.

ATTRACTIVE—plastic baked-enamel finish, scratch-resisting, washable . . . rounded corners, no projections . . . no "sweating".

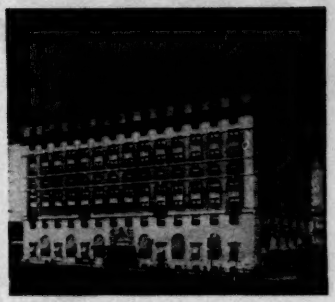
ECONOMICAL—thermally-insulated . . . large copper-finned cooling coils . . . Worthington Feather* Valves.

Each Worthington unit—3, 5 and 7½ ton sizes**—is built to the same high quality standards as Worthington equipment for engineered systems, such as those described at the right. *Write for Bulletin C1100-B29.*

*Reg. U. S. Pat. Off. **Also, for remote location: 7½, 10, 15, 20, 25 ton units

Another "Worthington-Conditioned" hotel

in the National Hotel Co. chain



The 400-room Washington Hotel, one of the leading hotels in the nation's capital, gets its air conditioning from a Worthington centrifugal refrigeration system, using chilled water. This is one of five National Hotel Company hotels to be Worthington-conditioned; the others are Hotel Jung, New Orleans; Travis Hotel, Dallas; Thomas Jefferson Hotel, Birmingham; Hotel Cortez, El Paso.

Off-and-On heat calls for Off-and-On cooling

The work performed in the research laboratory of Aluminum Company of America, East St. Louis, Ill., is of such a nature that excessive heat is produced intermittently.

Certain of the rooms are provided with a "wild zone" of air conditioning which goes into operation automatically when the heat-producing equipment is in use, and the normal air conditioning zone cannot handle the load.

This building is handled by a 125-ton Worthington air conditioning system comprised of two Freon-12 compressors and one evaporative condenser.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

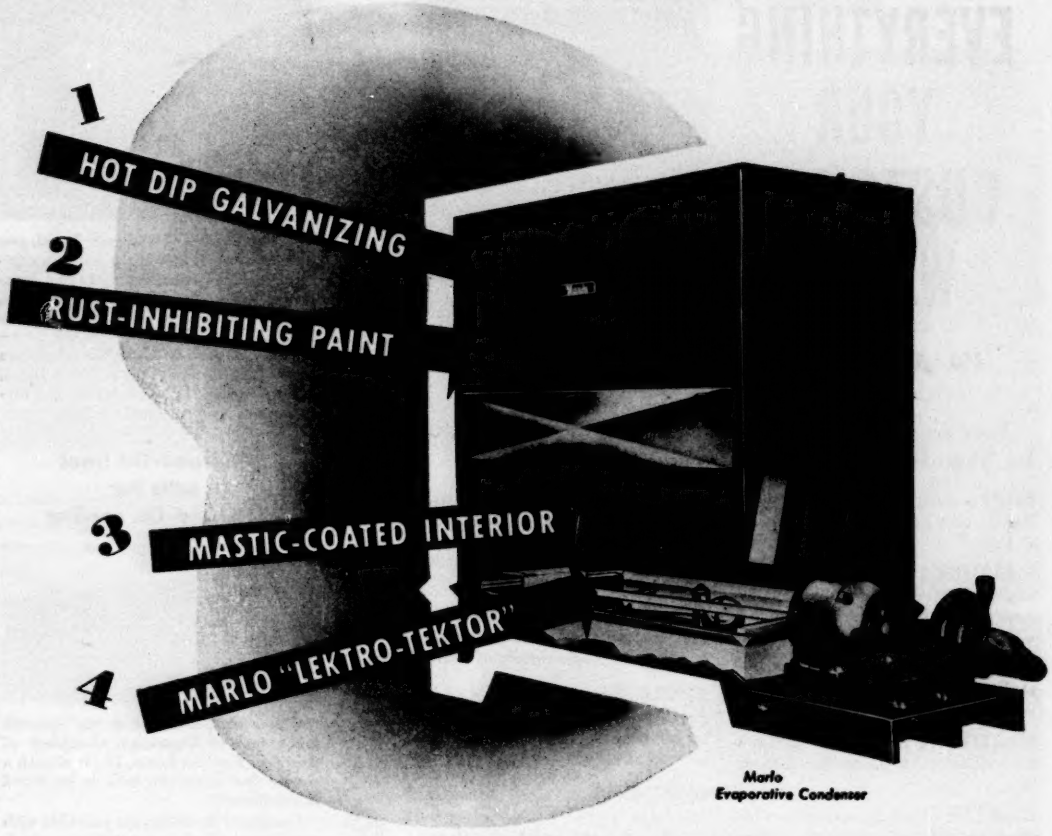
INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A.I.3

NOW...MORE IMPORTANT THAN EVER

...MARLO QUADRUPLE PROTECTION against CORROSION!



Marlo Evaporative Condenser

With greater emphasis being placed constantly on *endurance* of equipment, Marlo Evaporative Condensers and Cooling Towers offer this exclusive four-way protection to assure more dependable and longer-lasting installations for you:

OUTSIDE — Marlo galvanized sheets and frames are sprayed with a special rust-inhibiting alkyd resin-base paint that forms an extra front line barrier against corrosive elements.

INSIDE—sheets, panels and galvanized parts are coated with a sound deadening asbestos-asphalt mastic that doubles as an efficient corrosion-retardant. Marlo's exclusive "Lektro-Tektor" affords additional internal protection by preventing electrolytic sump tank corrosion.

Write for information on the complete Marlo line.

Marlo
MANUFACTURERS OF

COIL CO. • 6135 Manchester Rd. • St. Louis 10, Mo.

COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS
AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS

...to be sure of sound welds and fast assembly

L

TO MARK PROGRESS

Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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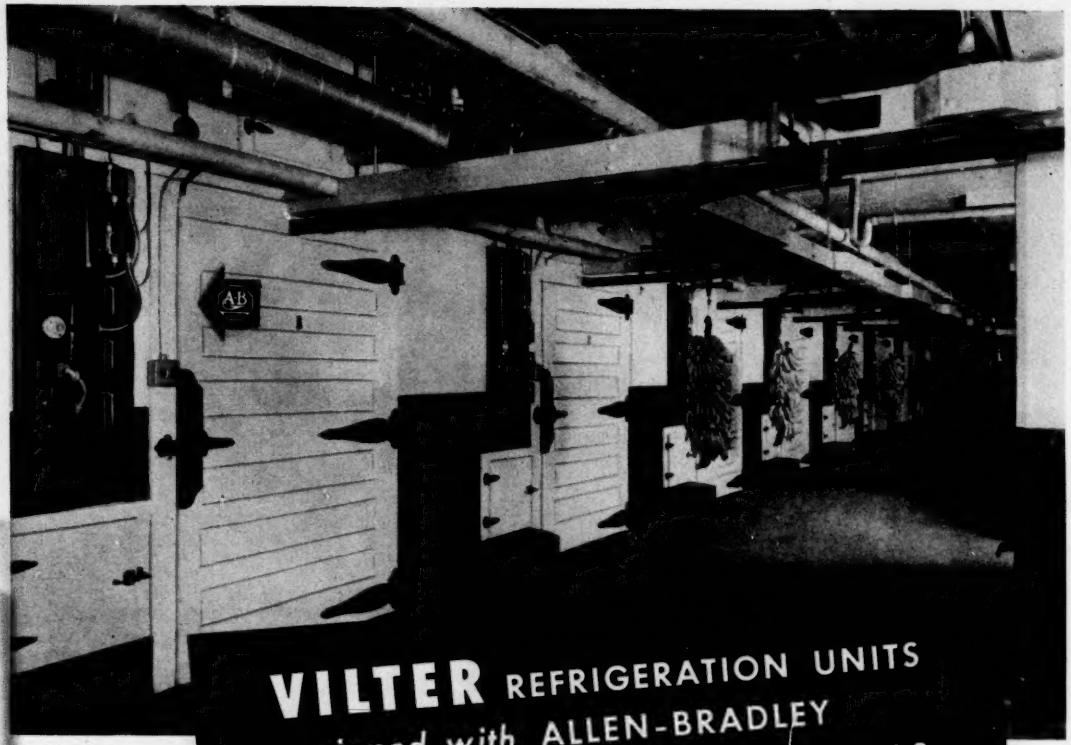


VILTER REFRIGERATION UNITS equipped with ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROLS

Vilter Refrigeration Units in a Detroit grocery equipped with A-B Bulletin 709 Solenoid Starters and Bulletin 712 Combination Starters... trouble free.

A-B Quality

Why are Allen-Bradley starters so popular for refrigeration and air-conditioning service? . . . Because they do not require regular attention; they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

No contact maintenance . . . Allen-Bradley patented silver alloy contacts never need cleaning, filing, or dressing.

Dependable overload relays . . . Allen-Bradley thermal relays are dependable and remain accurate in their operation, even after long service.

The Allen-Bradley trademark stands for millions of trouble free operations.

Allen-Bradley Co., 1330 S. Second St., Milwaukee 4, Wis.

BULLETIN 709 SOLENOID STARTER

Bulletin 709 Solenoid Starter for automatic across-the-line starting of squirrel cage motors. These starters are built in eight sizes, having a maximum rating of 300 hp, 208-220 v; 600 hp, 440-550 v. Dependable relays provide accurate overload protection. No voltage protection. White interiors and ample space for ease of wiring. Size 1 starter shown.

ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

Even the
BANK OF NEW YORK
—BANKS ON YORK

Take two multi-story buildings . . . Add that they were not designed for air conditioning, but that now air conditioning is wanted . . . Add that the most efficient use of funds is a must.

The sum total is a job unmistakably calling for York skill. As a result, the Bank of New York and Fifth Avenue Bank is now air conditioned by York—12 floors in its 48 Wall Street building and 13 floors in its 52 William Street building.

You are well acquainted with the difficulties of such an installation. And the choice of York to handle it points up York leadership again.

• • •

This is a timely illustration to cite because of two major developments that will increasingly affect the industry:

1 As new commercial construction is superseded by new defense work, there is a proportionately greater call for air conditioning in the modernization of existing buildings.

2 Air conditioning is being used more and more in the development of defense production techniques of still higher efficiency—a necessity and an exacting assignment.

In either situation, when you have an air conditioning problem you can profit by the things we have learned. Here's the York story to remember:

YORK offers you assistance with the most complete nationwide organization of trained engineers anywhere in the world.

YORK has had more experience in mechanical cooling than any other organization . . . 75 years of it . . . experience in doing jobs not easily solved by precedent.

YORK's CERTIFIED MAINTENANCE CONTRACT relieves you of post-installation responsibility, and relieves the client of maintenance for a known-in-advance service fee.

YORK works through you . . . wherever possible all contract air conditioning is channeled through architects, engineers, contractors.

Check today with your nearby York Representative listed in the classified directory, or write York Corporation, York, Penna.

Architects on Air Conditioning:
Voorhees Walker Foley & Smith
Contractor: *Buensod-Stacey, Inc.*
Consulting Engineers: *Meyer, Strong & Jones*

York

The big advances come from YORK

Headquarters for— **Refrigeration and Air Conditioning**

NOTES FROM AN ARCHITECT'S SKETCH PAD

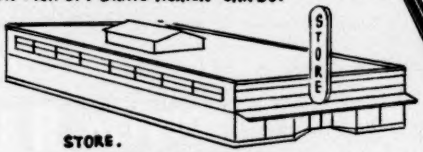
LOOKS LIKE THAT VERSATILE DRAVO "COUNTERFLO" HEATER CAN BE USED ON PRACTICALLY ALL OUR JOBS.

SCHOOL. DISTRICT BUDGET LIMITED. CAN SAVE WITH DRAVO HEATERS.

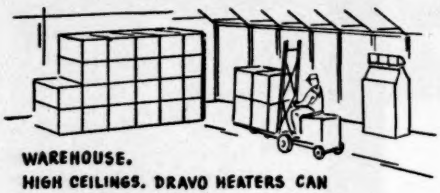
CHURCH. INTERMITTENT HEATING. NEEDS QUICK PICK-UP. DRAVO HEATER CAN DO.

INDUSTRIAL PLANT. DRAVO HEATERS HAVE 150' AIR THROW. NO DUCTS NEEDED.

ARMY BASE.
WINTER CONSTRUCTION ON THESE BARRACKS. CAN INSTALL DRAVO HEATERS EARLY FOR HEAT DURING CONSTRUCTION AND AFTER COMPLETION.

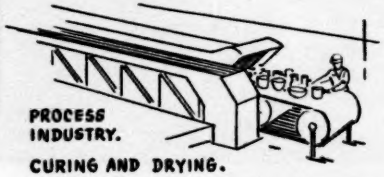


STORE.
WITH DRAVO HEATERS, CAN USE ONE SET OF DUCTS FOR HEATING AND AIR-CONDITIONING.

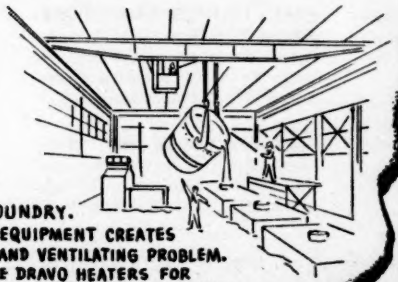


WAREHOUSE.
HIGH CEILINGS. DRAVO HEATERS CAN REDUCE ROOF HEAT LOSS, KEEP HEAT WHERE IT'S NEEDED.

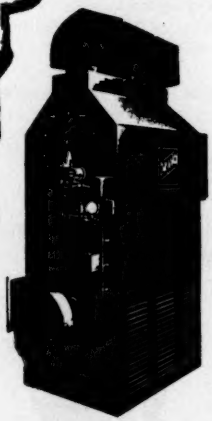
DIESEL RAILROAD SHOP. NEEDS HEAT AT WORKING LEVEL. DRAVO HEATERS IDEAL.



PROCESS INDUSTRY.
CURING AND DRYING. SPECIFY DRAVO HERE.



FOUNDRY.
EXHAUST EQUIPMENT CREATES HEATING AND VENTILATING PROBLEM. USE DRAVO HEATERS FOR TEMPERED "MAKE-UP" AIR.



A case study on any [illegible] installations is yours for the asking. For complete information on how Dravo "Counterflo" Heaters can help solve your heating problems, write for Bulletin LM-526-3

DRAVO CORPORATION

PITTSBURGH • CLEVELAND • PHILADELPHIA • DETROIT • NEW YORK • CHICAGO • ATLANTA • BOSTON

Sales Representatives in Principal Cities. Mfd. and Sold in Canada by Marine Industries, Ltd., Sorel, Quebec

Export Associates: Lynch, Wilde & Co., Washington 9, D. C.

YOU CAN DO A *BETTER* JOB WITH A

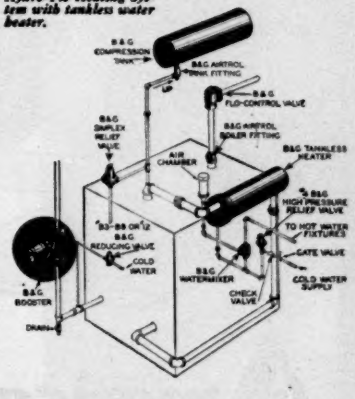
Year after year, more B & G Boosters are installed than any other pump built for the same purpose! This preference is based on the better design and precision workmanship which have produced an amazing record for failure-proof dependability.

The above cross-section of a B & G Booster reveals some of the reasons why this pump is so completely outstanding. Note these features *—compare them:*

1. Spring-type *silent* Coupler.
2. Highly polished, score-proof steel Shaft, with integral, electronically hardened thrust collar.
3. Diamond-bored bronze Bearings, made extra-long for quiet, long-lived operation.
4. Genuine *oil-circulating* lubrication system.
5. Water-tight Seal prevents water leakage into bearings—protects against emulsification of oil.
6. Impeller has true centrifugal construction—closely fitted to prevent water slippage.

If ever necessary, the B & G Booster is easily serviced. Johannson gauges are used throughout in construction and assembly, assuring positive accuracy of fit and complete interchange of parts from one pump to another.

Typical installation of single zone B & G Hydro-Flo Heating System with tankless water heater.



B&G Hydro-Flo Products protect your most valuable asset — customer satisfaction.

B & G Flo-Control Valve

B & G Monoflo Fitting

B & G Relief Valve (ASME Stamped)

B & G Deluxe Tankless Heater

BELL & GOSSETT
COMPANY

Dept. CB-4, Morton Grove, Ill.

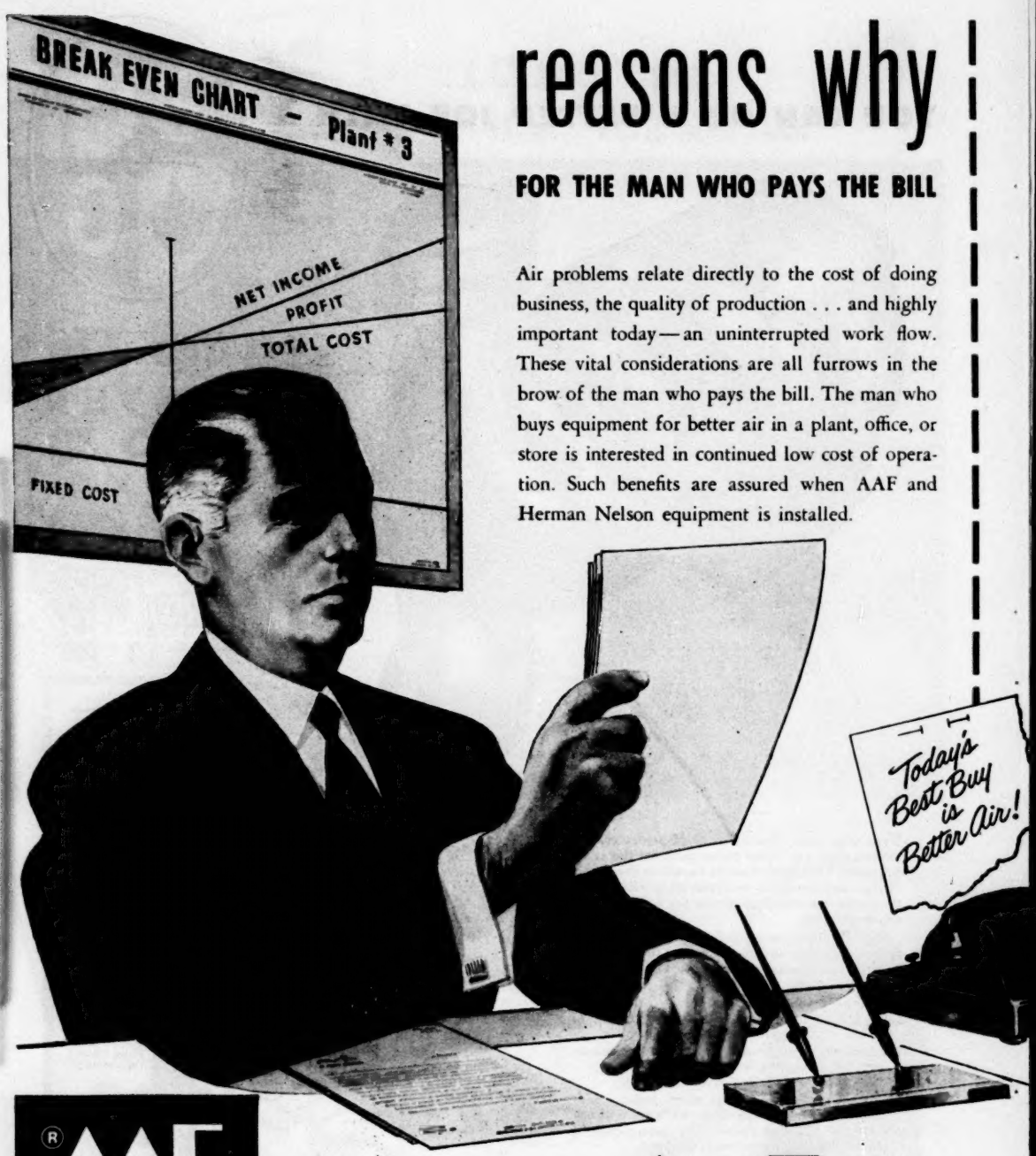
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Road, Toronto, Canada

•Reg. U. S. Pat. Off.

reasons why

FOR THE MAN WHO PAYS THE BILL

Air problems relate directly to the cost of doing business, the quality of production . . . and highly important today—an uninterrupted work flow. These vital considerations are all furrows in the brow of the man who pays the bill. The man who buys equipment for better air in a plant, office, or store is interested in continued low cost of operation. Such benefits are assured when AAF and Herman Nelson equipment is installed.



American Air Filter
COMPANY, INC.
HERMAN NELSON DIVISION

PLANTS: LOUISVILLE, KENTUCKY MOLINE, ILLINOIS

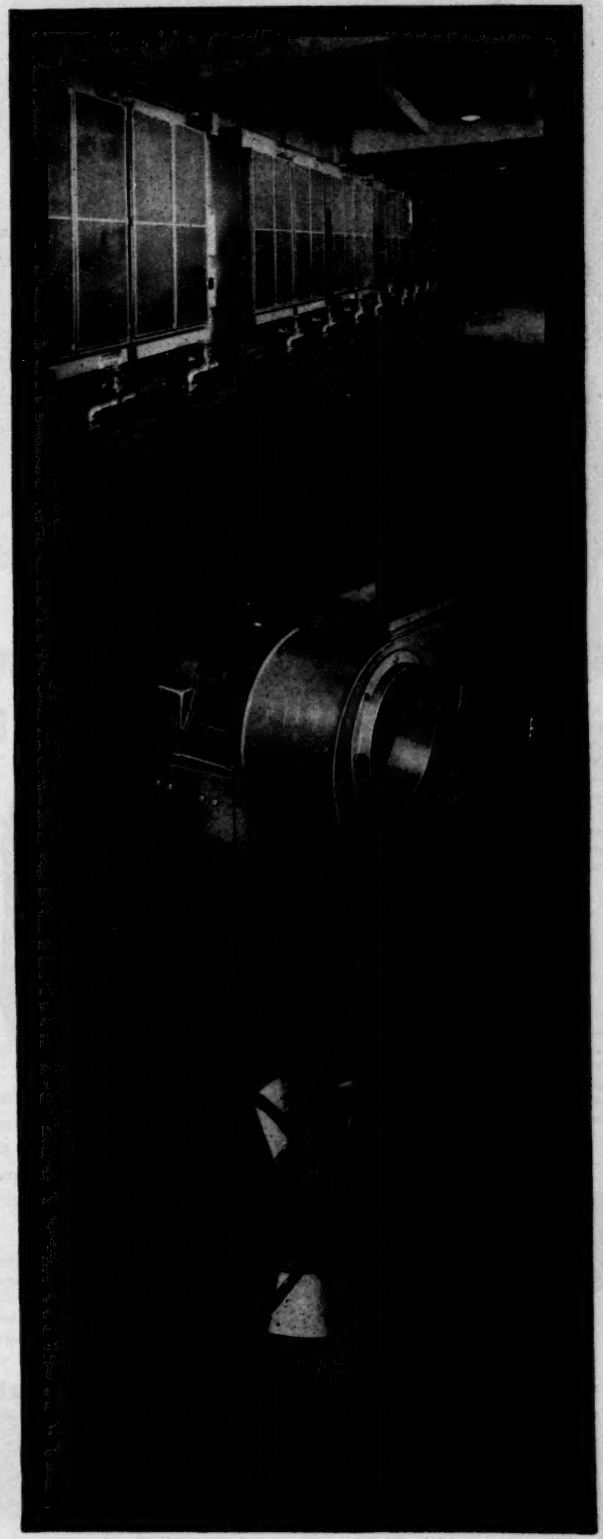
TYPICAL EXAMPLES OF EFFICIENCY IN OPERATION...

Take the case of AAF's Electro-MATIC. The installation at the right is protecting a huge investment in industrial equipment. It eliminates dust, dirt and even smoke from the air, so equipment will last longer . . . require less maintenance . . . perform more efficiently. The Electro-MATIC not only *super-cleans* air, but insures highest filtering efficiency at all times by automatic operation and self-cleaning features.

Only long-time engineering experience—the kind AAF has in abundance—can offer these advantages . . . the kind that makes sense to dollar-conscious management men who must pay the bill.

- Highest cleaning efficiency . . . over a wide range of particle sizes, from smoke to largest air-borne material.
- Minimum Maintenance . . . self-cleaning action and automatic operation eliminates shut-downs necessary with manual maintenance.
- Uniform Air Volume . . . provided by non-clogging filter curtain.
- Absolute Safety . . . as entire casing and exposed parts are electrically grounded.
- Easily Installed . . . in standardized self-contained sections that require no watertight duct construction.

Next time you have a problem involving air cleaning equipment, come to the one source that has all types of *specialized* air cleaning equipment . . . where you can be sure you won't be offered a substitute that isn't quite as good. Call on AAF, we'll be glad to work with you.



HERMAN NELSON

UNIT BLOWERS—Another outstanding example of a high efficiency, low maintenance cost unit that has become a standard specification for all Herman Nelson equipment. Compact in design for minimum space requirements, all Unit Blowers are assembled at the factory as complete ventilating units. Dependable and long lasting, these units are ideal where economy of operation and extra efficiency are both prime considerations. Tested and rated in accordance with Standard Test Code. Write for complete specifications and performance ratings.

PROPELLER FANS—Low initial installation and maintenance costs make Herman Nelson Propeller Fans the wise choice for the man who pays the bills. The exclusive "air foil" design of the fan blades increases efficiency and permits quieter operation. A wide range of models in either belt drive or direct drive has proven on installations to be the most economical form of mechanical ventilation obtainable. Write for descriptive booklet which gives sizes and performance data. Remember—there are good reasons why it's wise to buy the product that carries the Herman Nelson name.

Bryant Model 322 Unit Heater with A.G.A. inputs of 110, 135, 175, 210 thousand Btu per hour.

How to cut maintenance *Overhead*

Best bet for your industrial or commercial heating installation is *the* unit heater you can sell on the basis of *least maintenance.* That's where your customer looks for long-range economy and lasting satisfaction.

Tell him of the trouble-free operation of Bryant Gas Unit Heaters . . . how their specifically designed unit heater controls eliminate failures . . . how proper heat exchanger design prevents burnouts and squeezes a maximum of heat from every dollar's worth of fuel . . . how simple, time-saving installation of these Bryants meets his needs for comfort heating that's quick, automatic and without waste. These advantages mean *savings* for him.

And, once installed, you can count on these Bryant Unit Heaters for fewer call-backs . . . less trouble *overhead.* That's money in the bank for *you!*

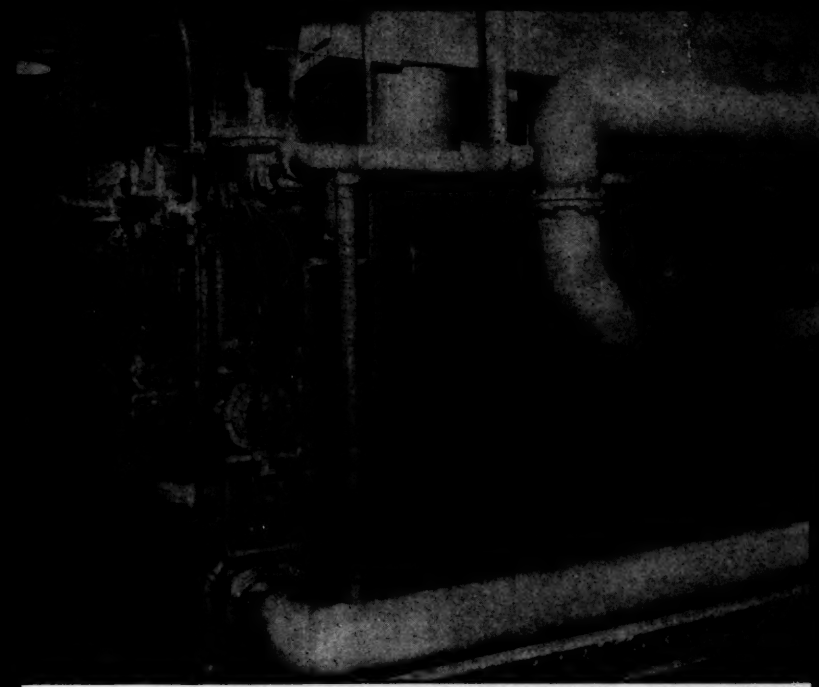
For a more complete story, contact the Bryant Distributor nearest you or write direct. Bryant Heater Division, Dept. 165, Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland 10, O.

Let the pup be furnace man . . . and water boy, too!

bryant

AUTOMATIC HEATING

Your *single source* of supply for everything in gas heating equipment!



. . . From big plant to home boiler

They All Need McDonnell Controls

No boiler installation is complete unless it is safeguarded from low water by the most dependable of all boiler water level controls — *McDonnell.*

Here you see a handsome battery of three Standard gas boilers in one of California's newest office buildings. Modern boilers, expertly installed, they are wisely protected by three McDonnell No. 51-2 feeder cut-off combinations.

Since good engineering accepts no unnecessary risks, you will almost invariably find McDonnell boiler water level controls a part of the modern engineered heating plants that are going in today. But this simply serves to emphasize the even greater need for McDonnell protection for boilers that will not be as carefully watched and attended as the large installations.

Whether large or small; whether hand fired, stoker fired, oil fired, or gas fired; whether low, medium, or high pressure . . . there is a McDonnell boiler water level control that will give every steam boiler maximum protection from the ever-lurking danger of low water. Typical controls are briefly described here. Ask for latest condensed catalog and price data.

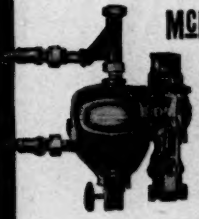
In addition to water level controls for steam boilers, McDonnell boiler protection includes Btu.-rated, A.S.M.E. standard safety relief valves for hot water heating boilers and domestic water heaters and tanks; also water feeders and low water fuel cut-offs for hot water heating boilers. All are described in the new Condensed Catalog.

McDONNELL & MILLER, INC., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One MM SAFETY *Thing Well*

McDonnell No. 51-2

McDonnell No. 51-2 feeder cut-off combination. This is the control installed on the battery of Standard Gas Boilers, opposite, product of American Radiator & Standard Sanitary Corporation. No. 51-2 is for boilers of any size; maximum steam pressure, 35 lbs. Feeder supplies water to maintain minimum water level; switch stops burner if emergency low-water condition should ever occur, making the boiler water level as automatic as the firing. Available without cut-off for hand fired boilers.



McDonnell No. 47-2

McDonnell No. 47-2 feeder cut-off combination. This control covers the largest class of heating boilers — up to 5000 sq. ft. capacity; maximum steam pressure, 25 lbs. Its operating cycle is the same as the No. 51-2. Available without switch for hand fired boilers.

McDonnell No. 150

No. 150 low water cut-off, pump control and low water alarm. This control is for higher pressure boilers of any size (up to 150 lbs.). It dependably starts and stops the electric boiler feed pumps in exact accordance with demands of boiler. Also functions as an emergency low water fuel cut-off and alarm.

McDONNELL

Heating?

Cooling?

Air Conditioning?

Process?

Here's How to Get the RIGHT Answer to your HEAT-EXCHANGE PROBLEMS

The right ratio of surfaces – the right materials – the right velocities – the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill – the unequalled manufacturing and testing facilities – which Aerofin offers you.

To get the *right* answer – ask the Aerofin man.

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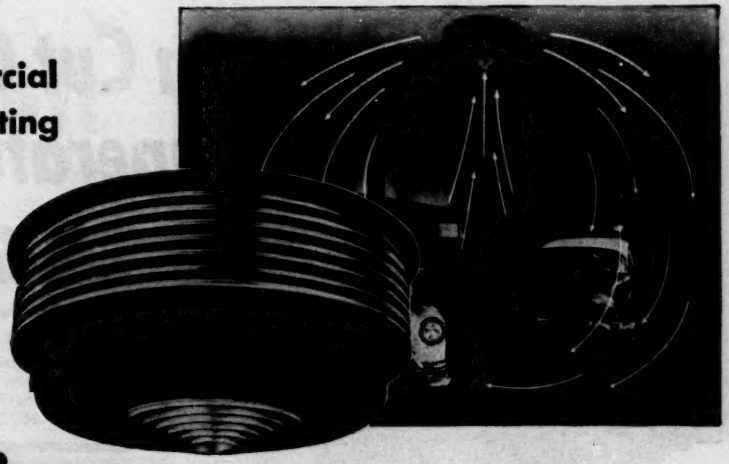
. . . for Commercial and Industrial Heating

All the Advantages of a Central Heating System in ONE forced convection OVERHEAD GAS HEATER
(U.S. Patent #2519496)

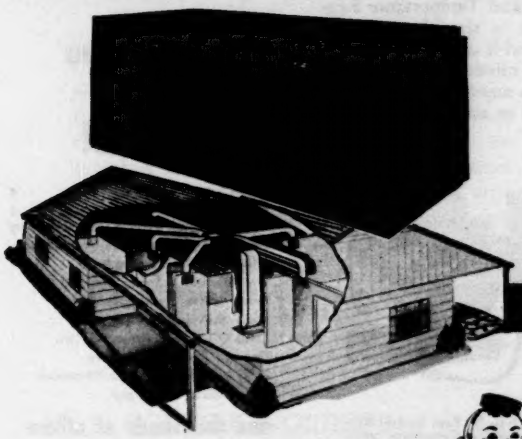


NEW *Norman* "THREE-SIXTY"

CIRCULAR DESIGN DISTRIBUTES HEAT HORIZONTALLY IN A 360° RADIUS

- NO BLAST of hot or cold air with 360 degree horizontal heat distribution.
- FORCED EXHAUST of Combustion Products Eliminates Draft Divertor and Venting Problems.
- FLUSH MOUNTING AND SHALLOW DEPTH Allows Ample Head Room in Low Ceiling Applications.
- EASILY AND QUICKLY INSTALLED in New or Remodeling Installations.
- LOW VELOCITY Impeller Assures Quiet, Comfortable Air Distribution.
- SMART STYLING—Controls and Venting Completely Concealed.

STEP AHEAD WITH NORMAN



. . . for Space Saving Residential Heating

Norman SOUTHERNER HORIZONTAL GAS FURNACE

The Original Compact Horizontally Designed Forced Air Gas Furnace for economical space-saving installation in attic, under floor, basement, closet. 4 sizes, 40,000 BTU to 100,000 BTU.

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I'm interested in "Stepping Ahead With Norman." Please send free literature giving full details and specifications on:

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FIRM NAME_____

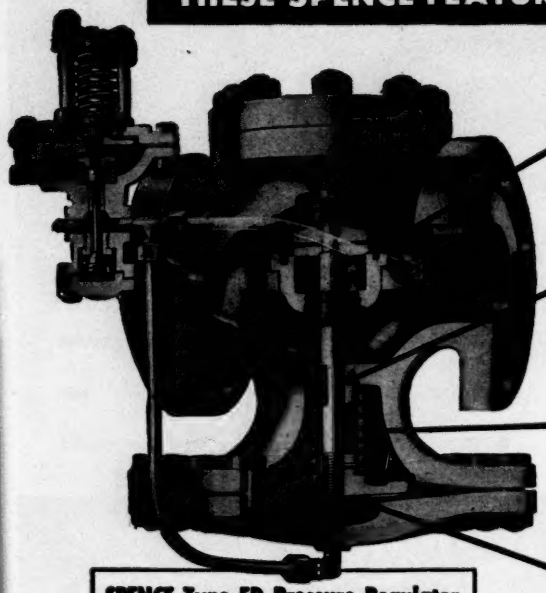
ADDRESS_____

CITY_____ ZONE___ STATE_____

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

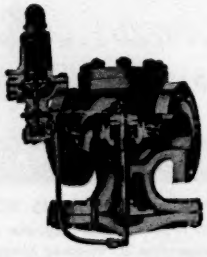
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

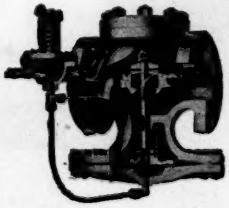
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type ET150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

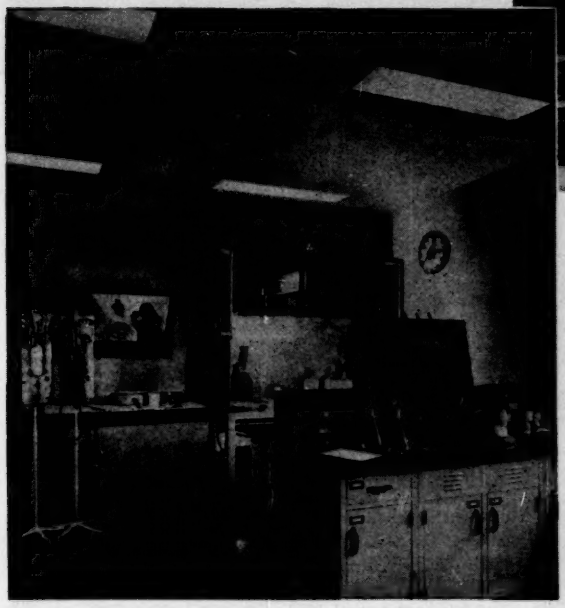
The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

kno·draft
adjustable air diffusers



for
air conditioning
efficiency
at Oak Ridge

Atomic energy plant at Oak Ridge, Tennessee, with detail of typical Kno-Draft *Adjustable* Air Diffuser.
Architects and Engineers: Skidmore, Owings, and Merrill.

Precise efficiency governs all operations at the U.S. Atomic Energy Commission's Oak Ridge plant. So distribution of conditioned air is through Kno-Draft *Adjustable* Air Diffusers—chosen because they circulate the air gently, *without drafts* . . . assure thorough, instantaneous mixing to maintain an even temperature throughout the conditioned area.

Also, Kno-Draft *Adjustable* Air Diffusers permit accurate control of air volume and direction *after* installation. This simplifies preliminary engineering and permits easily made changes to meet altered conditions—an important consideration.

Efficiency governed the choice of Kno-Draft at Oak Ridge. But for many installations, beauty is a first consideration. Kno-Draft *Adjustable* Air Diffusers have this, too . . . the quiet simplicity that fits unobtrusively into any surroundings. There are types and sizes to meet every requirement.

KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

TRADE MARK "KNO-DRAFT" REG. U. S. PAT. OFF.

W. B. CONNOR ENGINEERING CORP.
Danbury, Connecticut
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.
Dept. J-61, Danbury, Connecticut
Please send me, without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

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Position.....
Company.....
Street.....
City.....**Zone**.....**State**.....

MULTI-VENT

Low Velocity Air Diffusion CEILING PANELS

Architects — Narramore, Bain, Brady & Johnson.

Engineers — Lincoln Boullion & Associates

Multi-Vent Panels are installed throughout the Bank building, completely concealed in standard acoustical ceilings. Air is introduced and exhausted through the perforations in standard metal ceiling pans, eliminating all visible outlets or grilles.

For *COMPLAINT-FREE* Heating and Ventilating

IN THE SAN FRANCISCO FEDERAL RESERVE BANK, SEATTLE BRANCH

Top-flight engineers and architects are now specifying Multi-Vent for air distribution in virtually every type of commercial and industrial building, new or old, where *true comfort*, or where perfect uniformity and accurate control of air movement, temperature, and humidity is demanded by their clients.

For unlike any other diffuser on the market today, Multi-Vent panels do *not* depend on BLOW or THROW, (high velocity injection) for distribution. In fact Multi-Vent provides perfect over-all air distribution entirely by pressure displacement, completely free from BLOW.

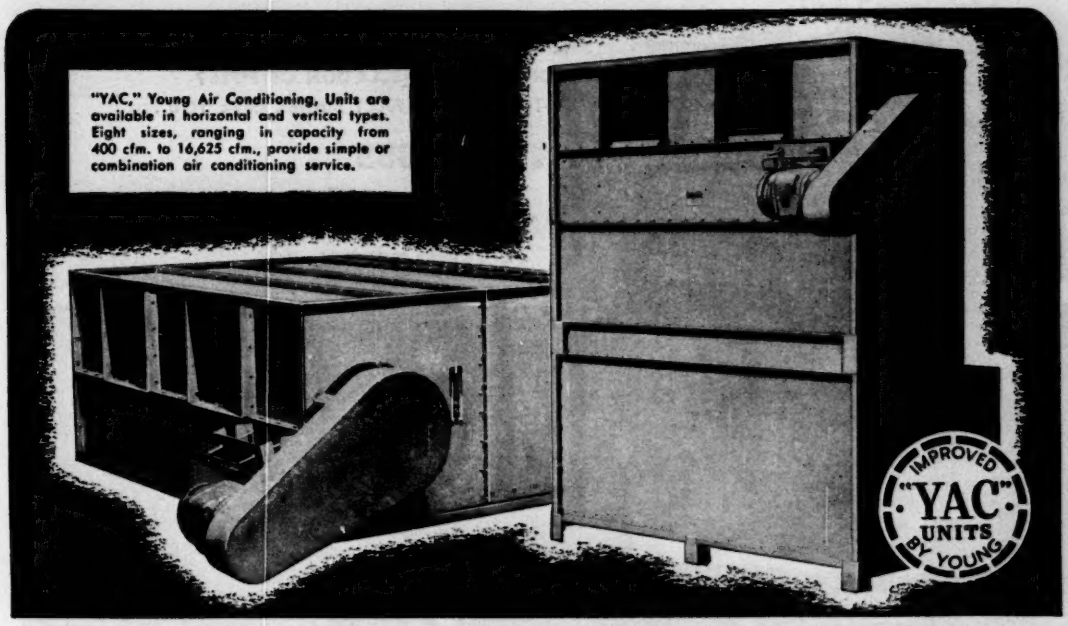
This pressure displacement principle, exclusive with Multi-Vent, does away with the main sources of draft hazards . . . thereby eliminating all of the most serious installation, balancing, and adjustment problems, inherent in the velocity injection principle, upon which all air diffusers *except* Multi-Vent depend.

Multi-Vent is by far and away the best, not only in performance, but in efficiency, appearance, and economy of maintenance as well.

See Sweet's Arch. & Eng. Files or write for detailed literature and the name of the Multi-Vent sales engineer in your vicinity.

THE PYLE-NATIONAL COMPANY
1374 NORTH KOSTNER AVENUE, CHICAGO 51, ILL.

MULTI-VENT DIVISION


"YAC," Young Air Conditioning, Units are available in horizontal and vertical types. Eight sizes, ranging in capacity from 400 cfm. to 16,625 cfm., provide simple or combination air conditioning service.
IMPROVED
"YAC"
UNITS
BY YOUNG

YOUNG SECTIONAL DESIGN OFFERS NEW VERSATILITY IN AIR CONDITIONING

You've plenty of latitude in specifying or installing "YAC" Air Conditioning Units by Young. They can be furnished in either horizontal or vertical types for ceiling or floor mounting, and with discharge direction as required. Motor, drive, and service connections can be located on either side.

We believe you'll appreciate the performance as well as the installation economies of "YAC" Units. Factory-built sub-assemblies and Young's advanced heat transfer engineering account for their design simplicity, operating efficiency, and growing popularity with Architects, Engineers, and Contractors. No matter what you expect from air conditioning equipment, next time call on Young to do it—and do it economically. Mail coupon, below, for further details and new "YAC" Catalog No. 7550.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

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Heating, Cooling, and Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY
DEPT. 521-F, RACINE, WISCONSIN

Factories at Racine, Wisconsin and Mattoon, Illinois
Sales and Engineering Representatives in All Principal Cities

LEARN HOW "YAC" SECTIONAL DESIGN CUTS HANDLING AND INSTALLATION TIME . . . .

YOUNG RADIATOR COMPANY
Dept. 521-F
Racine, Wisconsin

Please send me a copy of your catalog No. 7550 giving capacities, ratings, and dimensional data on "YAC" Air Conditioning Units by Young.

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ARE YOU WORKING ON ANY PROBLEMS
INVOLVING THE INSULATION OF PIPES?
LET THIS HELPFUL FACT FINDER GIVE YOU : : :

...Btu Loss
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2 GREAT PIPE INSULATIONS

UNIBESTOS No. 750
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WRITE today, on your company letterhead, giving your title or function. A "Fact Finder" will be sent to you together with complete information on UNIBESTOS Pipe Insulations No. 750 and No. 1200.

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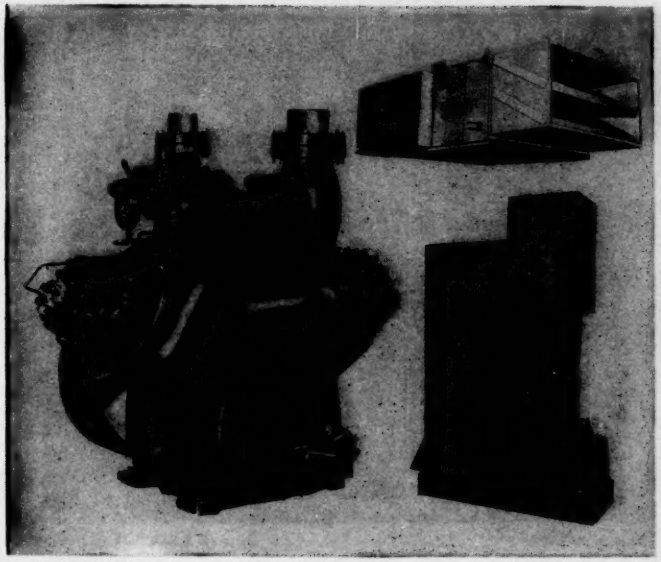


Who Makes a COMPLETE Freon Reciprocating System?

A completely integrated and balanced system—all *manufactured*, not just assembled, by the *one* manufacturer—that's Worthington.

No other company makes a wider variety of complete Freon reciprocating systems.

No other company offers more perfectly balanced operation of inter-related components—for lowest costs, longest life.

Worthington Freon-12 Compressors and Refrigeration Units. One basic compressor design covers a size range from 2 to 125 tons, with three cylinder sizes. Simplified construction. Lightweight automotive pistons. Worthington Feather* Valves—simplest, lightest, quietest ever made. Internal manifold. Renewable cylinder liners and leakproof, continually-cleanable force-feed lubrication in larger sizes. Positive manual or automatic capacity control. Available in self-contained compressor-condenser units.

Worthington Air-Handling Units. Perform complete air conditioning functions. Water cooling or direct expansion. Five sizes: 4 to 60 tons, 4000 to 13,500 cfm. Horizontal or vertical. Sectional design.

Worthington Evaporative Condensers. All parts exposed to moisture made of zinc-coated steel, bonderized and coated with rubber-base enamel containing special rust inhibitor. Prime surface—no fins to clog. Staggered coils permit air deflection and complete wetting. Six sizes from 2000 to 27,000 cfm.

Also: *Worthington Evaporative Coolers* in same range.

*Reg. U. S. Pat. Off.

Bulletins containing complete information are available

First Completely Air-Conditioned Apartment House in New England

Beacon Towers Apartments, Brookline, Mass. is the first building of its type in New England to be 100% air-conditioned.

E. A. Berman Company of Boston, under the direction of M. L. Cail, installed a three-zone cooling water system for the 34 apartments. Individual room units are served by a refrigeration unit consisting of a Worthington Freon-12 compressor, evaporative condenser and water chiller.

The system is designed and operated for automatic heating in winter and cooling in summer.

Experience of the owners has been that the air conditioning helped to lease the apartments for 3-year periods.

Laboratory Air Conditioning Duplicates Mill Conditions

Worthington also manufactures a complete line of *centrifugal* refrigeration.

When the W. Harrison Hightower Textile Engineering Building was built at the Georgia Institute of Technology, Atlanta, to house its textile school, Worthington refrigeration for air conditioning was installed to provide the proper temperature and relative humidity required for textile processing.

Fourteen separate rooms are individually air-conditioned, through a chilled water system, from a 150-ton Worthington centrifugal refrigeration system, electrically-driven. This machine is equipped to shut off automatically in the event of trouble anywhere in the system.

Installed by Engineering Contractors, Atlanta, Ga.

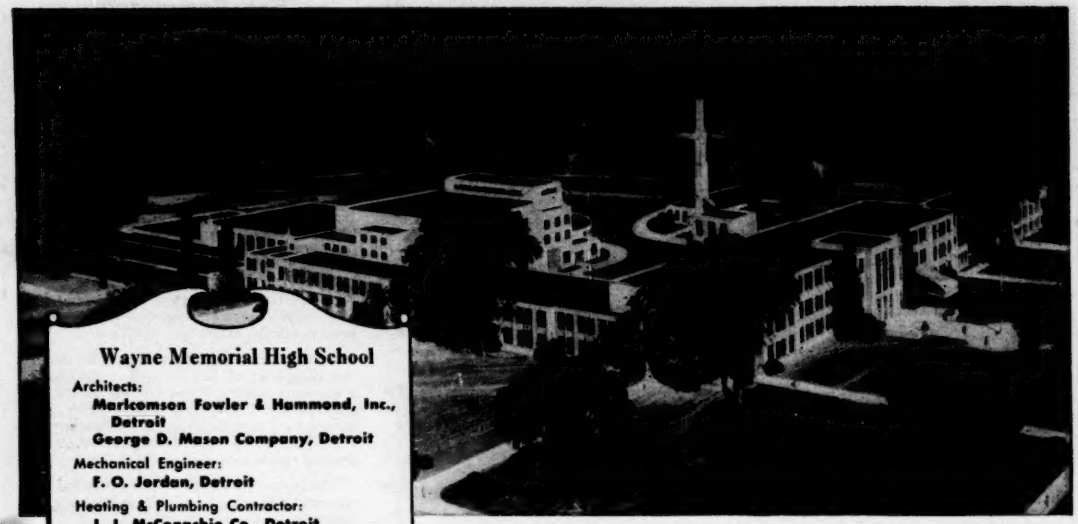
WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE

MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A-1.1



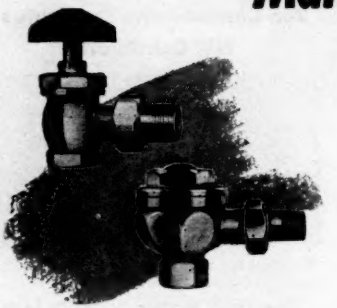
Wayne Memorial High School

Architects:
Marlcomson Fowler & Hammond, Inc., Detroit
George D. Mason Company, Detroit

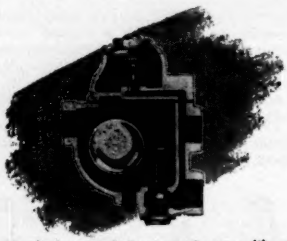
Mechanical Engineer:
F. O. Jordan, Detroit

Heating & Plumbing Contractor:
L. L. McConachie Co., Detroit

Marsh Valves and Traps Throughout



Marsh Packless Valves and Radiator Traps were chosen throughout for the Wayne Memorial High School. The most permanent packless valve construction is the Marsh metal-to-metal seal and the best team-mate for this better valve is the Marsh radiator trap.



Marsh float and thermostatic traps like this were used in the Wayne High School.

Pride of its community is this modern 3½ million dollar high school at Wayne, Michigan, near Detroit. It is a worthy addition to the growing list of model school buildings that are rising to the call of the tremendously increased number of young folks who are going in for more and more education.

Such buildings are planned and erected to become a lasting part of community activities; so it is significant that a large number of Marsh valves and traps were used in the well-engineered system which heats the laboratories, library, cafeteria, gymnasium, offices and classrooms.

But high tribute though it is, the selection of Marsh equipment here is simply one more example of the preference accorded Marsh heating specialties by foremost heating engineers and contractors in every section of America.

For your next job consider the equipment that is first choice of the most critical heating men. Write for the Marsh heating specialties catalog, 76-H, covering Marsh valves, traps, venting devices and the dollar-saving Marsh Tri-Trol regulator.

MARSH HEATING EQUIPMENT CO.
Sales affiliate of Jas. P. Marsh Corporation
Dept. U, Skokie, Ill.

BIG FUEL SAVING WHEN HEAT REGULATION IS IN STEP WITH THE WEATHER:—

Marsh Tri-Trol is the simple, low-cost, easily installed heat regulator for multiple occupancy buildings from smallest to largest. Ask for bulletin showing how it gives ideal heating comfort at lowest cost by controlling heating in accordance with outside temperature.

MARSH *Heating Specialties* **SINCE 1865**

Remember—

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In special alloy piping systems, alloy TUBE-TURN Welding Lap Joint Stub Ends permit use of lower-cost carbon-steel flanges as shown in cut-away view.

Special alloys lick special piping problems

Write Dept. B-8 for free booklet "Pipe and Fitting Materials" which gives specifications, properties and welding procedures for various materials.

YOU can overcome special problems of corrosion, fluid contamination, pressure, or temperature by selecting pipe and welding fittings of special materials.

Tube Turns, Inc. continually studies the proper application of different materials to piping systems. The complete line of TUBE-TURN Welding Fittings is available in more than forty different alloys. Today's piping engineer can choose from intermediate and high alloy steels containing chromium, nickel, or both; commercially pure nickel, copper, and aluminum; and alloys of these.

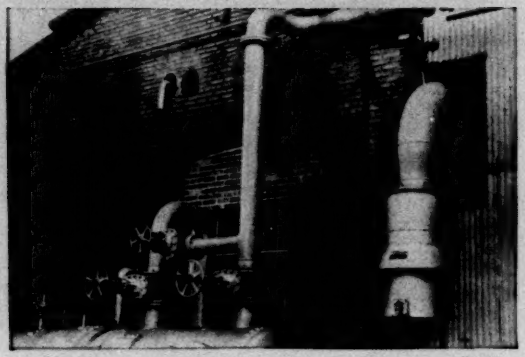
Get in touch with your nearby Tube Turns' Distributor. You'll find one in every principal city.

"Be sure you see the double tt"

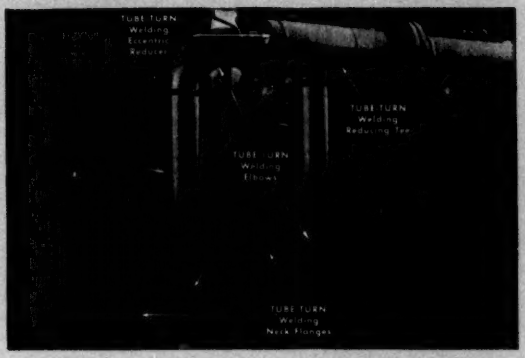
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

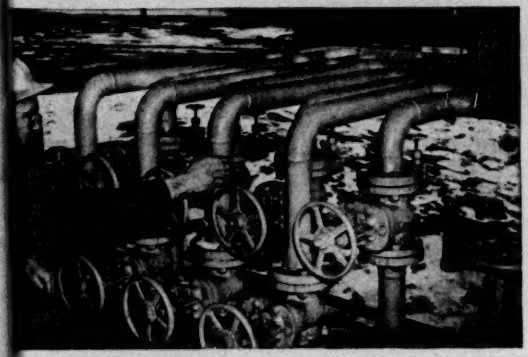
Piping construction simplified by wide range of TUBE-TURN Welding Fittings



Welding complex process piping calls for a wide variety of fittings and flanges. In this installation, air is drawn into compressor through a 16-inch line, connected to an outdoor filter through a TUBE-TURN Welding Reducer. Air at 100 lbs. is piped to the compressor tank through an 8-inch welded line.

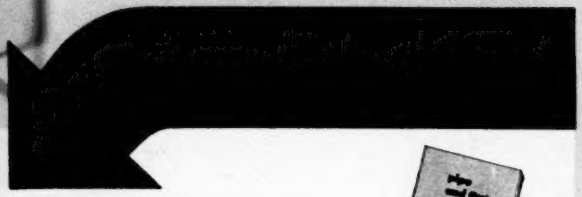


Manifold serves air lines to various shops. Matching the two 8-inch lines to the 12-inch line here was no problem. Use of a TUBE-TURN Reducing Outlet Tee and a TUBE-TURN Eccentric Reducer made the construction job easy. The main line can be opened easily at the TUBE-TURN Welding Flanges.



mall lines tap off fire foam chemical manifold, lead to storage reas and other critical locations. Leakage or weak joints here ould be disastrous. Welded piping with strong TUBE-TURN elding Fittings makes this fire protection reliable.

In fabricating, welders appreciate the true circularity of TUBE-TURN Welding Fittings. To fill an immediate need, a welding elbow is often cut to make an odd-angle welding fitting. Unique forging process assures that TUBE-TURN Welding Elbows can be cut at any angle and still match the pipe for proper welds.



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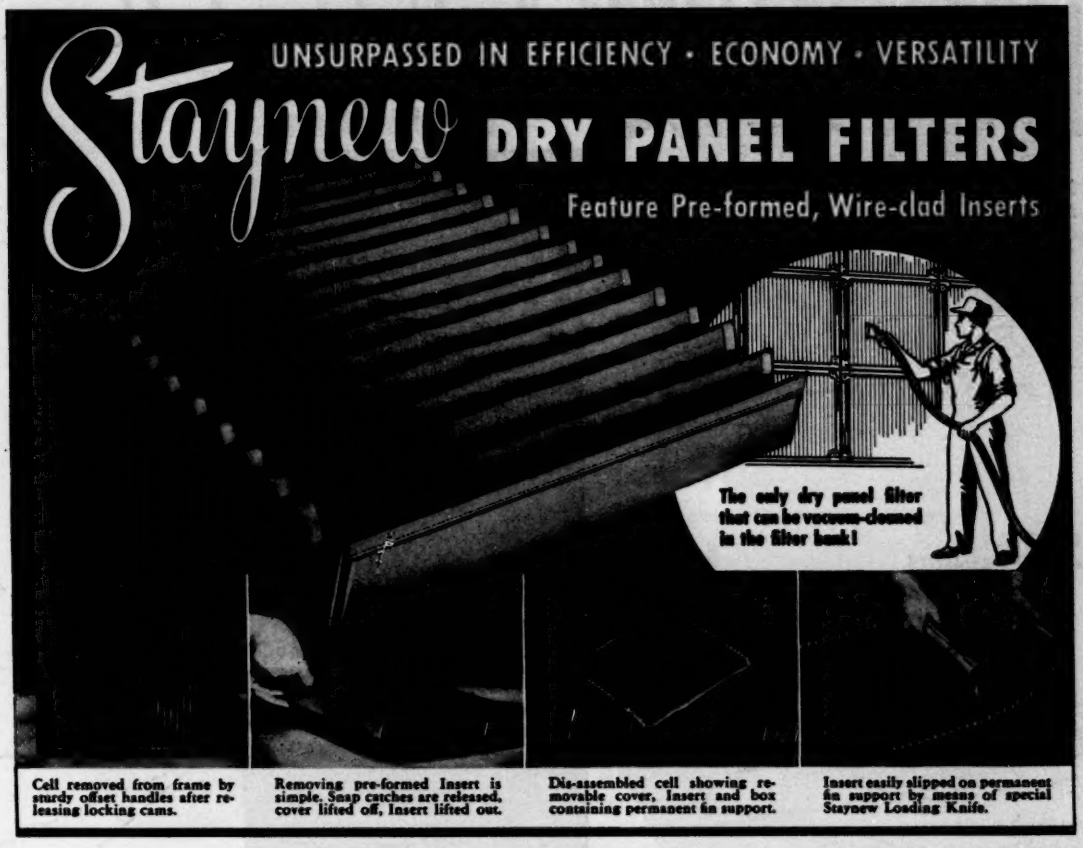
Staynew DRY PANEL FILTERS

Feature Pre-formed, Wire-clad Inserts



Cell removed from frame by sturdy offset handles after releasing locking cams.

Removing pre-formed Insert is simple. Snap catches are released, cover lifted off, Insert lifted out.

Dis-assembled cell showing removable cover, Insert and box containing permanent fin support.

Insert easily slipped on permanent fin support by means of special Staynew Loading Knife.

. . . *pre-formed* so that Inserts can be slipped on or off the permanent fins in seconds! . . . *wire-clad* for complete protection of medium and maximum fire resistance! . . . *Class I Underwriters' Approval* in bonded glass!

FIN CONSTRUCTION provides the greatest possible filtering area in available space. Resistance in relation to dust load is less than in panel filters built on any other principle.

OPERATING ECONOMY is amazing. The most fragile medium can be cleaned repeatedly either by vacuum or fluid (dry-cleaning). Insert replacement cost is very low.

STAYNEW DRY PANEL FILTERS are *versatile* . . . utilizing any medium in sheet form that can be crimped. Stock media include wool felt, rayon-cotton-wool felt, bonded glass, and Feltex. The latter is a surprisingly low cost, highly efficient medium.

INSTALLATION can be in flat or V-banks, frames riveted but individual cells removable in a matter of seconds. All standard sizes are available in 2″, 4″ and 8″ depths.

FOR EVERY DRY PANEL NEED there is a Staynew model and medium for maximum efficiency at minimum cost.

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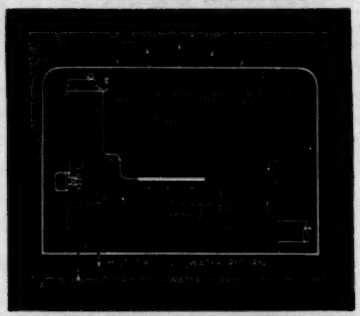
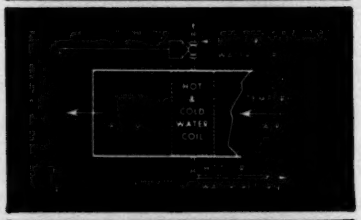
DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

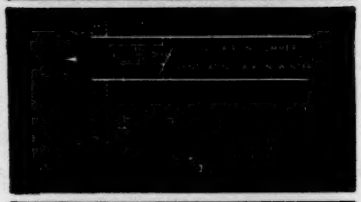
POWERS *Individual Room Control*

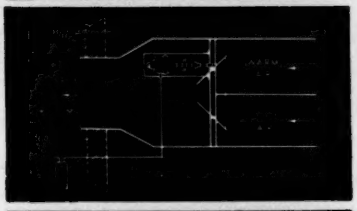


For systems using high pressure primary air in room unit

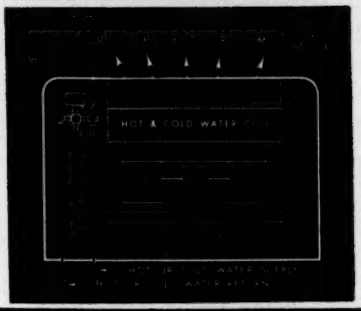


For systems using individual coil in duct to each room





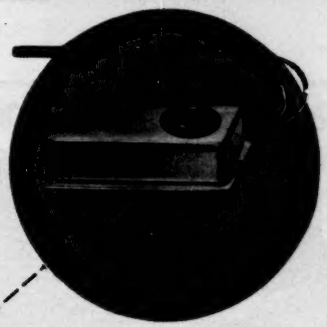
For systems using volume or mixing damper in duct to each room

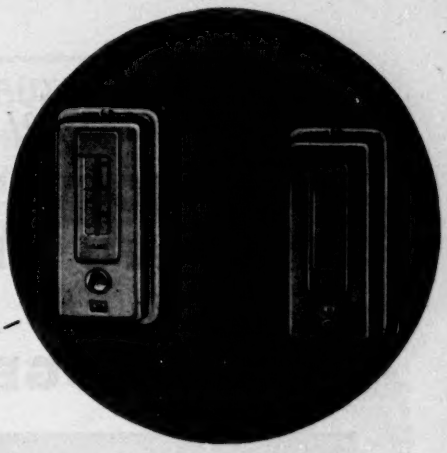


For systems using fan in room unit

For

Air Conditioning





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Modern Standards of Comfort

. . . demand the many advantages of air conditioning systems with individual room control. To insure the best performance from this type of air conditioning regulate it with a Powers pneumatic system of temperature control.

With the experience gained from installations in many prominent buildings we may be able to help you select the type of control best suited for your requirements. Phone or write our nearest office, there is no obligation.

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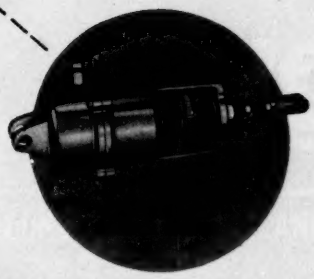
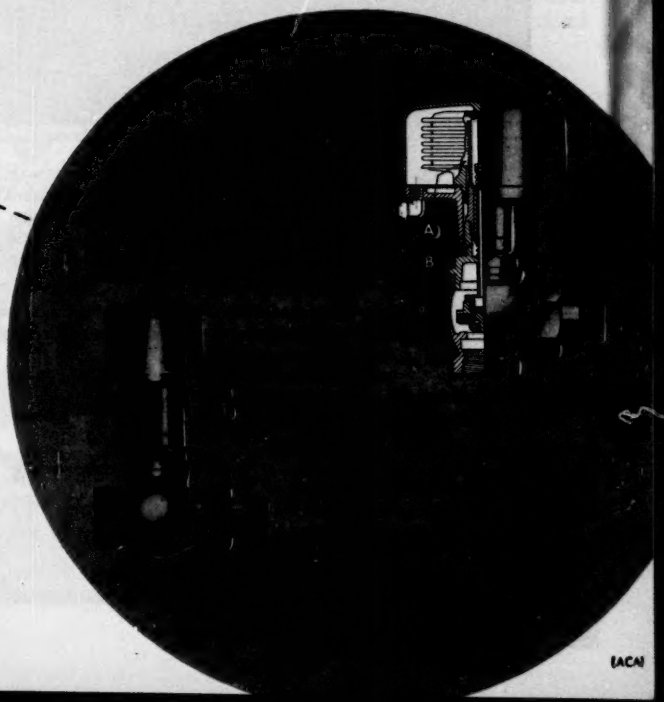




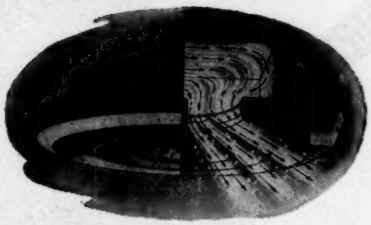
Systems

(ACA)

Naturally
ANEMOSTAT AIR DIFFUSERS *are at* OAK RIDGE

At Oak Ridge, the selection of every piece of equipment was of vital importance. They needed and got the best. That's why Anemostat Draftless Air Diffusers were chosen not only for the planned community, but for the production facilities as well. These pictures of the high school auditorium and workshop, designed by Skidmore, Owings and Merrill, show but two of the many Anemostat applications.

Anemostat has been a part of the atomic energy program since its inception. Today Anemostat Air Diffusers provide draftless air distribution in atomic energy projects throughout the nation.



Here, graphically presented, is the aspiration principle that makes the Anemostat Air Diffuser superior. Due to its patented design, the Anemostat distributes air of any duct velocity in a multiplicity of planes traveling in all directions. Simultaneously, the unit creates a series of counter-currents which siphon room-air into the device equal to about 35% of the supply-air. Room-air is mixed with supply-air *within* the Anemostat before the air-mixture is discharged into the room.

ANEMOSTAT®

DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA
10 EAST 39th STREET, NEW YORK 16, N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES

AC 1274 "NO AIR CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

Good workmen + good tools + GOOD PIPE = GOOD JOB!

7 POINTS OF UNIFORM GOODNESS IN YOUNGSTOWN STEEL PIPE

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
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WHEN your die is sharp and true, you enjoy cutting threads on Youngstown pipe. That's because it's so uniformly soft, so round and uniform in size. It has the toughness and strength, too, that make your threads full and well formed, clean and sharp. The name "Youngstown," rolled into every length, tells you it's GOOD PIPE.

QUALITY YOUNGSTOWN SERVICE

Youngstown STEEL PIPE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

PIPE AND TUBULAR PRODUCTS — WIRE — ELECTROLYTIC TIN PLATE — COKE TIN PLATE — STRIP
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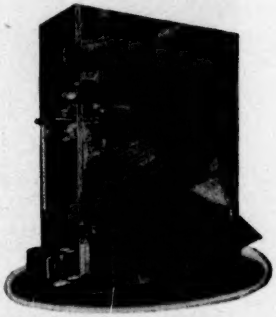
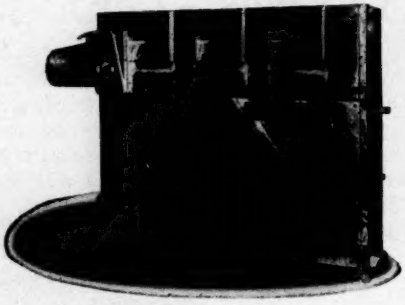
ACME Products have been manufactured continuously for more than 30 years. ACME Products are universally accepted and noted for their dependability and fine workmanship. ACME published ratings are accurate and conservative. ACME'S 30 years of engineering experience gives you economy, long life and increased efficiency on which you can build a greater volume of business and increased profits.

EVAPORATIVE CONDENSERS AND HEAVY DUTY COOLING TOWERS

1. Heavier, extra strong construction for durability. **2.** Complete moisture elimination for dry fan operation. **3.** Save more than 90% of the water required. **4.** Built in 3 sections for easy shipment and installation. **5.** Flexible fan arrangement. **6.** Hot-dip galvanized *after* fabrication. **7.** Internally mounted receivers for added storage capacity. **8.** Provision for Micromet threshold water treatment. ALL the above features, with the exception of "internally mounted receivers" and "Micromet threshold water treatment" are also available in ACME Heavy Duty Cooling Towers.





BLO-COLD* INDUSTRIAL UNIT COOLERS

1. Units available for Dry Coil or Brine Spray Operation. **2.** Available for flooded, direct expansion or brine operation. **3.** Coils may be either prime surface or finned; tubes of copper or steel pipes. Fins aluminum or steel. Coils, steel pipes and fins may be hot-dip galvanized. **4.** Vertical or horizontal discharge, easy accessibility to coils. **5.** Economical to operate. **6.** Air inlet front or back.

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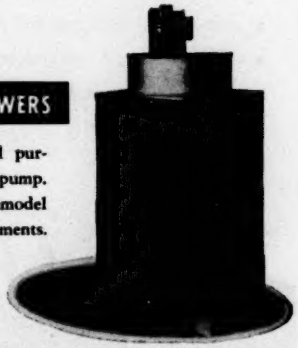
1. Versatile — Model for all purposes. **2.** With or without pump. **3.** An ideal Jobber item, stock model can be used to meet all requirements.



ACME ALSO MANUFACTURES: Ammonia Condensers ● Freon Condensers ● Shell and Coil and Shell and Tube Condensers ● Dry-Ex* Water Coolers ● Hi-Peak* Water Coolers ● Fin Coils ● Pipe Coils ● Oil Separators ● Liquid Receivers ● Heat Exchangers ● Flow-Cold* Liquid Chillers ● Convectors

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ACME INDUSTRIES, INCORPORATED
JACKSON, MICHIGAN

CONTINUOUSLY SERVING THE REFRIGERATION INDUSTRY SINCE 1919

Washington News

LORING F. OVERMAN

ALL preliminary estimates as to the requirements of defense industries and the essential civilian economy under the Controlled Materials Plan were knocked into a cocked hat as early as mid-May when some 30-odd government claimant agencies filed proposals which would have taken up from 135 to 140% of the basic steel supply. Estimates of requirements for copper and aluminum were correspondingly inflated.

Determined efforts will be made to squeeze all possible water out of the proposed programs before the Controlled Materials Plan takes over, on July 1, the programming of specified manufacture involving the use of steel, copper and aluminum.

Extent of the inflated proposals is apparent when it is recalled that the discrepancies showed up as early as mid-month, although May 31 was set as the deadline for receiving estimates of metals requirements from producers of military and defense-supporting industries.

On the assumption that the total of the foregoing requirements would require only a healthy fraction of the total production, the CMP program had been announced as an "open end" affair. This meant that certain essential programs would be programmed, but that beyond the needs of the military and government claimant agencies, there would be an open zone of supply in which producers of many civilian items would find plenty of opportunity to pick up a considerable portion of their normal supplies.

Cutbacks Forecast

Discrepancies in the materials estimates were so severe as to justify a full-dress press conference on May 17, with top Defense Production Administration officials outlining next steps. Explainers were Edwin T. Gibson, DPA administrator, and Charles E. Wampler, assistant administrator for program and requirements for DPA.

According to present plans of making adjustments, the first objective will be to meet the demands of the military, Mr. Gibson explained. DPA has received the assurance of the Defense Department that materials will not be taken in advance of need, he said.

The second objective will be to take care of the basic industrial expansion program. About 6 million tons of steel will be needed in the third quarter for that purpose. As tight as the steel supply will be in that quarter, the copper and aluminum picture is even less bright, Mr. Gibson explained, and cutbacks are inevitable.

Explaining the program more in detail, Mr. Wampler said that the military and munitions programs will get 100% of their needs, with the basic facilities expansion program running a close second. This means that enough steel, copper and aluminum will be made available to meet not only direct military needs, but for the expansion of machine tool and general component production.

The civilian economy will come at the bottom of the list of claimants, the DPA spokesmen said, but they indicated that every effort will be made to temper dislocations as much as possible.

In the middle area—flanked on one side by military and direct defense-supporting activities and on the other by consumer goods production—industrial expansion will have to be cut somewhat, Mr. Wampler indicated. How much these cuts will be is being determined during the early June audit of CMP estimates filed with claimant agencies.

Whatever the outcome of the materials audit, some may find it encouraging to know that the claimant agencies charged with estimating the needs of essential civilian industries have been overzealous in filing their claims. It is less encouraging, however, to note that Washington has again been over-generous in adding up totals.

On second thought, it should be noted that the claimant agencies did not themselves originate the estimates. They compiled them from figures filed by those they were supposed to represent. It is even possible that the claimant agencies may have pared the estimates somewhat before submitting them to headquarters. So as a result of greediness on the part of those who actually originated the estimates, the figures must be slashed by top-level edicts—possibly with less consideration for dislocations than might have followed honest estimates in the first place.

Next Steps in CMP

For all who must operate under CMP—and that includes makers of some 4,000 products requiring steel, copper or aluminum in all but the most minute quantities—a new booklet "The ABC's of CMP" is required reading. Copies may be obtained from NPA, Washington 25, D. C., or from field offices of the Department of Commerce. The booklet describes, under topic headings, CMP fundamentals, regulations, definitions and materials; how the plan operates; what roles are played by government and industry; CMP product classifications, and the scope of the program.

Estimates of requirements for the third quarter of this year were to have been filed by May 31, and the "water" is now being squeezed out. Next, NPA will issue production schedules authorizing the completion of specified quantities of products, together with an allotment of the controlled materials (steel, copper, aluminum), necessary to fabricate the schedules.

Producers of heating, ventilating and air conditioning equipment will become producers of "A" products only if they convert all or part of their production to military items, or if their products are adapted in such a way as to be suitable only for military use.

In case the plant is producing an "A" product—one suitable only for military use—it will obtain an authorized production schedule and an allotment of controlled

is as bad as dirty filters!

Get this Booklet—The "Comparative Study of Air Filtering Costs" contains facts, figures and charts important to anyone interested in air conditioning. A copy free on request. Write today.

Sure, it's crazy . . . nobody would choke off the air conditioning intentionally! But you get roughly the same effect when you let dirt-choked air filters remain in your system. You lose comfort and raise your costs.

Regular, periodic replacement of filters is a *must* if you want to get good air conditioning and avoid costly repairs. How often should you replace them? As often as they get dirty . . . and that depends on your local conditions . . . in some cases as often as once a month.

Be sure your filter replacement is handled on a definite schedule, using nationally known and accepted Fiberglas DUST-STOP* Air Filters, the replacement filters that provide high dirt-catching capacity at no extra cost.

Your DUST-STOP supplier can help you set up a way of handling filters systematically. Discuss it with him today. Owens-Corning Fiberglas Corporation, Dept. 41-F, Toledo 1, Ohio.

*DUST-STOP is the trade-mark of Owens-Corning Fiberglas Corporation for impingement type air filters made of glass fibers. FIBERGLAS is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

materials simultaneously from a government procurement agency. If the plant is a prime contractor it may pass a portion of the allotment along to subcontractors.

If our heating, ventilating and air conditioning plant is called upon to deliver a "B" product—one which it customarily mass-produces—for use in a CMP-authorized military or essential civilian program, no allotment of materials will be received from the purchaser. Instead, the industry division to which our plant must look for supplies, will have authorized the plant to produce a certain number of the units, and will have set aside the controlled materials.

Assuming that the over-all program of producing heating, ventilating and air conditioning equipment has been cut, there is no precise formula for dividing the materials available among industry members. It does not follow that a 20% cut in the allotments requested by the industry division will be automatically shared by all producers in the program. Rather, the industry division reserves the right to distribute controlled materials in a manner designed to make the best use of available materials. This could mean that everybody shares the cut, or that historical patterns decide the method of distribution.

The "B" product producer, once he receives his allotment, doesn't have to pass some along to his subcontractors or suppliers. It is to be assumed that if he needs an electric motor, or a temperature control instrument, the producers of those items will have anticipated their needs and requested allotments from their own industry claimant divisions. There is a single exception in the case of producers of aluminum castings or carbon or alloy steel forgings. In that one case, "B" product producers must supply necessary allotments.

Conversion of Orders

H & V producers who have placed orders for steel, copper and aluminum with producers or distributors, calling for delivery after July 1, 1951, may, under certain conditions, convert such orders to authorized controlled materials orders. On conversion the orders would regain their places in delivery schedules.

To make the conversion, producers of "A" or "B" products must apply for and obtain authorized production schedules or instructions as provided in CMP Regulation 1. They must also obtain materials allotments. Once this process is completed, the suppliers must either be furnished with a revised order or with information clearly identifying the order. New orders, like authorized controlled materials orders, must contain the allotment number, the period for which the allotment is valid, and a certification that the order has been placed pursuant to CMP Regulation 1.

The advantage of conversion would be that in the third quarter, producers of "A" or "B" producers would regain their original places in the mill or distributor schedules. Otherwise outstanding rated and undated orders for production materials would be pushed back on mill schedules to leave room for the DO-rated orders which carry an allotment symbol or number.

Construction Curtailed

NPA Construction Order M-4, issued last October to ban new building for amusement purposes, has been successively tightened to such an extent that NPA permits are now required before starting virtually all non-defense projects requiring more than 25 tons of steel.

Because of the new provisions, effective May 3 and May 11, NPA authorization will now be required for such major construction as industrial plants and facilities, schools, churches, hospitals, highways, bridges, water and sewer systems, pipelines, public utility and railroad construction. The May 3 amendment even included construction projects directly related to the defense program, but the May 11 version removed that prohibition.

NPA intends to relate the amended order M-4 closely to the Controlled Materials Plan, in which the construction industry will participate. When CMP becomes effective July 1, builders will apply for allocations of materials for their projects, using CMP Regulation 6 (soon to be issued) as their guide. By screening applications, NPA will be in a position to know the amounts of scarce materials needed for projects determined to be essential.

The screening will also make it possible for NPA to require modification of plans to assure all possible conservation of critical materials in approved projects. This operation will be in addition to the restrictions on the use of construction materials contained in other NPA regulations.

For the purposes of M-4, all construction is placed in four categories. The exempt classification includes all construction by or for the Department of Defense, Atomic Energy Commission, or the National Advisory Committee for Aeronautics. List A includes all currently prohibited construction, such as recreation facilities. List B concerns important commercial construction, and List C covers luxury homes (priced above $35,000), large apartment buildings, radio and television broadcasting facilities, terminal warehouses and other unlisted projects requiring more than 25 tons of steel.

Most List B applications (and as soon as feasible all List C applications) will be screened by field offices of NPA. The Washington office is currently screening List C applications; List B applications where construction costs exceed $1,000,000 or where the project uses more than 50 tons of steel; and all List A applications.

Billion A Week

Military spending during the first three months of 1951 was at the rate of a billion dollars a week, including $1.8 billion during the quarter for military construction and facilities expansion.

Deliveries on Defense Department orders are being made at a rate considerably slower than the rate of placing orders. For many of the principal items of modern defense equipment an exceptionally long lead time is required. In some instances there may be a lag of two to three years between the time an order is placed and the date of delivery.

BRIEFLY STATED

• The Central Military Procurement Information Office of the Munitions Board has revised the "Index of Military Purchasing Offices: A guide to Industry in Selling the Military Departments." The guide lists all the procurement items assigned to each of the military departments for combined buying, together with the location of Army, Navy and Air Force offices responsible for buying each item. Copies available on request from Industrial Services Branch, Office of Public Information, Room 2A858, The Pentagon, Washington, D. C.

• Noma Electric Corporation has acquired for a cash consideration the Automatic Burner Corp. of Chicago, producer of ABC oil burners. Prior to the acquisition by Noma, Automatic Burner was a privately owned company. It will be operated as a wholly-owned subsidiary. No change is contemplated in personnel.

• Both the size and number of steam air conditioning installations have grown by leaps and bounds since 1930, when the first steam jet cooling system—a 225-ton unit—was installed in New York City, according to New York Steam Corp. Today, 58 installations, with a total cooling capacity of 32,688 tons, provide purchased steam air conditioning in many of Manhattan's great buildings.

• Construction work has begun on the Texas Gas Transmission Corp.'s Alford underground storage field near Petersburg, Ind., as part of a program that will supplement deliveries of natural gas by 30 million cubic feet daily during periods of extreme cold weather. Work calls for construction of 12 miles of connecting pipe line, a 1,200 horsepower compressor station, a storage gas measuring station and 4.5 miles of storage field lines. It is expected that the new underground facilities will be completed and the field re-pressured by November.

• The School of Modern Heating, sponsored by The Institute of Boiler and Radiator Manufacturers, celebrated its first anniversary on April 11. A total of more than 2,500 students have attended the School in 44 cities since it began in Hartford, Conn., a year ago.

• Production and marketing of heat pumps, a system of all-year air conditioning, will be increased in 1951. Nine manufacturers are expanding production and development plans, says the Plumbing and Heating Industries Bureau.

• Sales of cast iron radiators in 1950 were 58.1% ahead of sales in 1949. In 1950, 77.9% of cast iron hot water and steam heating boilers sold were automatically fired. This figure compares with 67.3% for 1949. Boilers sold in 1950 were substantially smaller than those sold in 1949. While the number of boilers sold increased 45.3%, the gain in tonnage was only 28.7%.

• The Building Research Advisory Board has secured authorization from its parent organization, the National Academy of Sciences-National Research Council, for the creation of a complementary and supporting organization called the Building Research Institute. The Institute will provide membership representation from the building industry. Acting also as a liaison agency, it will answer the need of the thirty-member BRAB for greater contact with all those interested in building research.

• Authorizations to place delivery orders for oil-country tubular goods—casing, tubing, and drill pipe—for shipment from U. S. mills during July have been issued by the National Production Authority to 41 petroleum operators for use in drilling oil and gas wells in 20 foreign countries.

• Installations of commercial and industrial sizes of underfeed stokers for the first quarter of this year in the City of Chicago totaled 218 units compared with 184 for the corresponding period in 1950, according to statistics compiled by the Midwest Stoker Association from reports issued by the City's Department of Smoke Inspection and Abatement. Permits were issued for 415 oil-burning installations for the first three months of 1951 compared with 303 in 1950, and 23 gas-burners were installed in the January-March period this year compared with 45 in 1950.

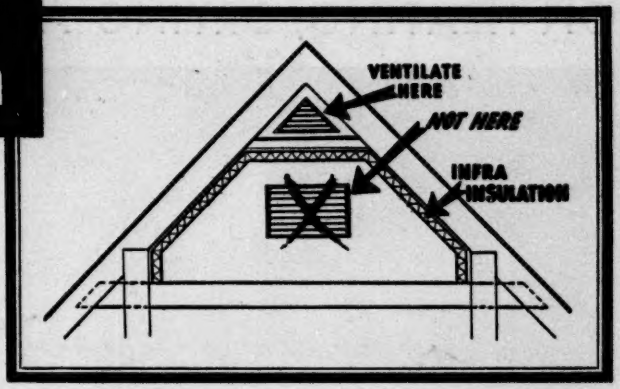
• Returns from a survey recently completed by the American Gas Association which indicated that nearly one million new gas househeating customers are expected to be added to present lists during the 1951-1952 househeating season, and that another 900,000 new househeating customers are anticipated in the 1952-1953 season. The expanded survey indicated that approximately nine million dwelling units were using gas for all househeating purposes on January 1, 1951.

• Three tall new buildings now rising in Pittsburgh's Golden Triangle will be completely air conditioned with the largest Carrier Conduit Weathermaster installation in the world. Two of the buildings will be 20 stories high, and the third 24 stories, providing a total rentable area of some 850,000 square feet—enough to increase the entire city's present office space total by about 15%. Completion is scheduled for 1952. Equitable Life Assurance Society of the United States is the owner. Approximately 6,000 Weathermaster room units will be installed—about 50% more than the total for the United Nations Secretariat building, the largest previous installation.

• The American Standard Safety Code for Mechanical Refrigeration, ASA B9.1-1950, sponsored by ASRE, has been adopted as an American Standard. To answer questions as to interpretation of the intent of some of the provisions, the ASA B-9 committee has appointed an interpretations subcommittee which will meet quarterly, with E. T. Benson, Frigidaire Division, General Motors Corp., as chairman, and M. C. Turpin, ASRE, as secretary.

Don't Vent Below Insulation

Vents below insulation let heated air out, cold air in, waste fuel in winter. This defeats the purpose of insulation, which is to prevent the escape of heat.



Ventilation is generally necessary above all insulations, less in residences, more in buildings where crowds or other conditions create large amounts of water vapor. Where roof rafters are insulated, it is good practice to cap under the ridge, insulate across, and ventilate above.

With ordinary insulation, at least 1 sq. in. of free opening is needed for each 4 sq. ft. of ceiling and wall surface exposed to vapor flow. No point in the vented space should be more than 25 ft. from a vent opening. Adequate ventilation takes care of vapor which seeps through into a building space from within, and of evaporated water which leaks in through nail holes and other openings from without. In summer, attic vents help lessen the heat load imposed by the sun.

Multiple accordion aluminum is non-condensation forming, non-absorbent. Since it is impermeable to vapor, it will slowly force out, even without vents, ordinary amounts of fortuitous vapor which has leaked in through openings in the outside walls. (To do this, an insulation must have a permeability no greater than one-fifth that of the colder outer wall or roof.) Venting accelerates this process.

Multiple accordion aluminum turns back 97% of the infra-red rays striking it; emits from its opposite surface but 3%. There is negligible conduction, and convection is blocked. The commercial form of multiple accordion aluminum, with 6 integral reflective spaces and 6 reflective surfaces is Infra Insulation Type 6.

THERMAL FACTORS, TYPE 6 INFRA
Down-Heat C.044, R22.72 equals 7½" DRY Rockwool
Up-Heat C.080, R12.50 equals 4" DRY Rockwool
Wall-Heat C.073, R13.69 equals 4½" DRY Rockwool
VAPOR PERMEABILITY equals ZERO

INFRA INSULATION, INC.
10 Murray Street New York, N. Y.
Telephone: COrtlandt 7-3833

INFRA INSULATION, INC.
10 Murray Street, New York, N. Y. Dept. V-6.
Please send "Simplified Physics of Vapor and Thermal Insulation."

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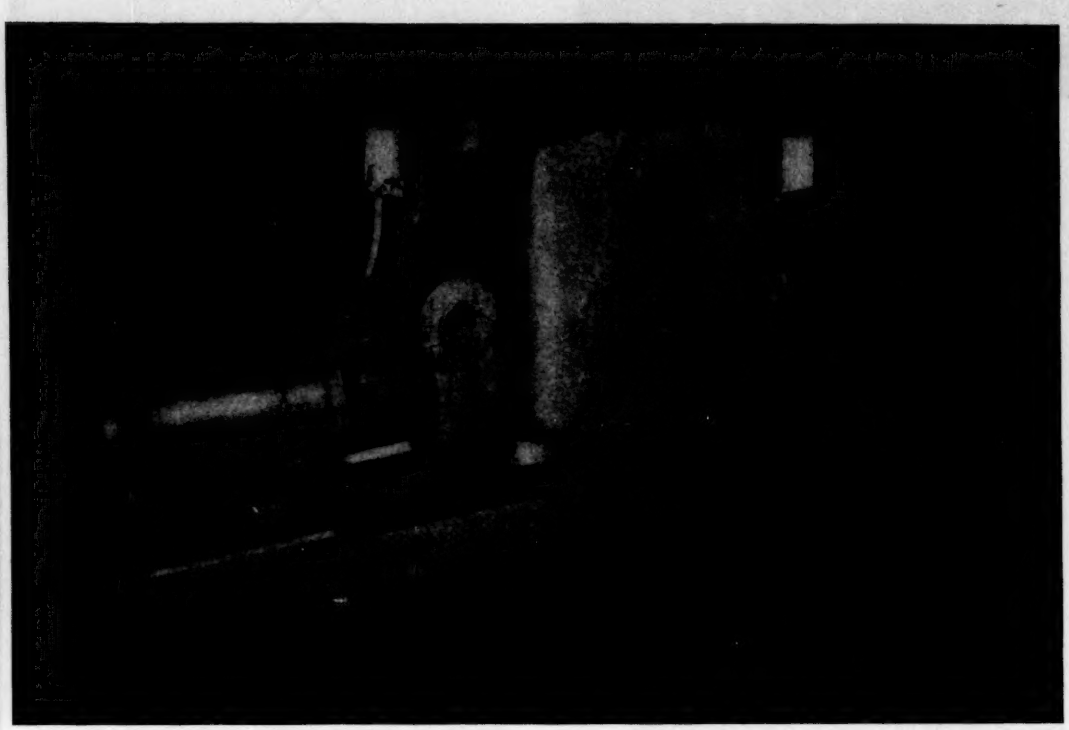
☐ Send Prices of Infra Insulations ☐ Send Sample

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



JENNINGS CONDENSATION PUMPS

Designed for steam systems on heating, drying, or process work, these pumps offer the most reliable and efficient means of returning hot condensate to boiler or hot well. In many cases these pumps will save costly installation of boilers in a pit to provide gravity flow of returns from basement radiators and heating devices.

The Jennings Condensation Pumps are sturdy and compact in construction, and combine receiving tank, pump and driving motor in a single assembly. Pumps are bronze fitted throughout, with tobin bronze shaft. The pumping impeller is of special design, made possible by our wide experience with return line heating pumps, and is especially adapted for handling hot water with the greatest possible efficiency.

Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

Steam Requirements for Commercial Laundries

Starchroom Laundry Journal

A. E. HUNTER
Power Engineer, Duquesne Light Co., Pittsburgh, Pa.

Data of value to design and operating engineers are presented regarding power requirements for commercial laundry machines, hot water needs, heat reclaimers and process steam. Diagrams clarify water and heat flows.

MOST commercial laundries throughout the United States employ electric motors to drive their power-using equipment. All of this power is purchased by many laundries, others generate all power required; while still others use both purchased and generated power in some combination thought by the owners to best suit their peculiar needs.

The fact that electric motors are found in common usage in commercial laundries, affords a convenient basis for determining hot water and process steam requirements. The relationship between power usage, quantity of hot wash water and the amount of steam needed for drying and pressing may not be obvious to the casual observer. However, numerous laundry studies, in which these quantities were carefully metered, have established the fact that they are closely related. The following discussion enlarges upon this interesting relationship.

Electric Power Requirements

Since electric power consumption is to be used as the common denominator in this discussion, let's look into the question as to how much power a laundry requires. If a laundry is already in operation and is using complete purchased electric service (recent years have witnessed a strong trend of laundries toward the use of total purchased electric service), the utility company can furnish data on total electric usage and probably can give the breakdown between lighting and power. Then, too, the electric bills will at least show the total monthly kilowatt-hours used. Generally, the motor load accounts for about 80% of the total electrical usage, while the remaining 20% goes for lighting. If some or all of the power is generated by the laundry, it is comparatively simple to install a suitable electric meter to measure the quantity of power produced. If both lighting and power are distributed by the same circuits, it is safe to assume 80% of the total energy used is supplied to the motor load.

The total monthly electrical requirements may also be quite accurately approximated by multiplying the total connected horsepower of motor load by either 90 or 100, depending upon whether the laundry operates the equivalent of five 8-hour days a week or works, in addition, a half day on Saturday. For example, if the sum of all connected motors totals 100 hp, the total electric requirements of such a laundry operating 40 hours a week will be very nearly 100 $\times$ 90 or 9,000 kwh a month, of which 9,000 $\times$ 0.8 or 7,200 kwh would be used by motors and the remainder, 9,000 — 7,200 or 1,800 kwh a month would be chargeable to lighting.

Boiler Plant

The peak steam load of laundries is practically the same regardless of whether power is generated or

TABLE 1—MAXIMUM BOILER HORSEPOWER REQUIREMENTS FOR LAUNDRY MACHINES.

Equipment	Size, Inches	BHP	Size, Inches	BHP
Presses	25	0.3	45	1.0
	38	0.7	51	1.2
	40	1.0	52	1.5
	Collar Equipment			
Collar and cuff Ironer		0.8		
Ironer	24	1.5	40	3.0
	30	2.0	50	4.0
	Shirt Equipment			
Single cuff		0.25		
Neckband		0.25		
No. 3		0.25		
Yoke		0.25		
Bosom		1.50		
Body		1.00		
Sleeve (2)		0.50		
	Handy Ironers			
Single roll	54	1.2	80	1.75
	66	1.5	100	2.0
	Tumblers			
Tumblers	36 × 36	2.0	40 × 94	12.0
	30 × 42	2.5	42 × 42	7.5
	36 × 48	6.0	42 × 60	11.0
	40 × 44	5.8	42 × 90	16.0
	40 × 64	8.2	42 × 120	22.0
	Conveyor Dry Room			
2-Loop		5		
3-Loop		6		
4-Loop		11		
2 + 2 Loop		10		
2 + 3 Loop		11		
3 + 3 Loop		12		
4 + 4 Loop		16		
	Truck Dry Room			
1-Door		2		
1½-Door		3		
2-Door		4		
4-Door		7		
6-Door		10		
	Curtain Dryers			
Curtain Dryers	50 × 114	1.0	64 × 130	2.0
	Miscellaneous			
Starcher	14	0.25	24	0.5
	18	0.25		
Hose Form (7)		1.0		
Blanket Dry Room		0.75 per draw		

purchased. This is due to the fact that peak process and water heating steam requirements may occur simultaneously many times a day. For this reason, the same boiler capacity is required for a laundry generating its entire power requirements as for one purchasing all of its electric service. The use of reasonably efficient steam engines is assumed.

Flat work ironers, dry tumblers, presses and similar equipment are for the most part designed to operate on relatively high pressure steam so that the working pressure of a typical laundry boiler installation is usually in the neighborhood of 100 lb gage.

The boiler capacity required for the average laundry that does not employ heat recovery is about 2.5 to 3 boiler horsepower per connected motor horsepower. For example, a boiler of about 300 hp capacity would be required in the case of a laundry having a connected motor load of 100 hp.

Steam Demands of Laundry Machines

Tables 1 and 2, taken from data published by the American Institute of Laundering and Fred H. Schaub Engineering Co., Inc., show the maximum individual boiler horsepower requirements of the several items of high pressure steam-using equipment. Obviously the sum of the individual demands would amount to more than the total boiler capacity needed. However, this table will serve as a guide for sizing a branch steam line to a particular machine or machine-group.

Process Steam Requirements

Steam at 85 to 100 lb gage is required for the satisfactory operation of flat work ironers, presses and dry tumblers. Actual metered data on a representative number of commercial laundries indicates that the total quantity of steam required for these process uses amounts to 65 to 70 lb per kilowatt-hour of energy consumed by the laundry's motors. On this basis, a laundry with a connected motor load of 100 hp and a monthly power consumption of 7,200 kwh, would use 70 × 7,200 × 12 or about 6,050,000 lb process steam a year.

Hot Water Requirements

The average commercial laundry uses large quan-

TABLE 2—MAXIMUM BOILER HORSEPOWER REQUIREMENTS FOR FLATWORK IRONERS

Size, Inches	Type	BHP	Hp Breakdown per Roll (or Cylinder)
100-110	4-Roll	7.0	Approx. 2.25 hp for each of first 2 rolls; 1.25 hp for each of last 2 rolls.
120	4-Roll	8.0	2.5 hp for each of first 2 rolls; 1.5 hp each for last 2 rolls.
100-110	6-Roll	11.0	2.25 hp for each of first 2 rolls; 1.25 hp for each of last 4 rolls.
120	6-Roll	12.0	2.5 hp for each of first 2 rolls; 1.75 hp for each of last 4 rolls.
100	8-Roll	14.5	2.25 hp for each of first 2 rolls; 1.7 hp for each of last 6 rolls.
120	8-Roll	16.0	2.5 hp for each of first 2 rolls; 1.8 hp for each of last 6 rolls.
40 x 120	2-cyl (Ash)	10.0	5 hp per cylinder.
48 x 120	1-cyl (Ash)	8.0	.....
24	1-cyl (Monitor)	8.0	.....
30	1-cyl (Monitor)	12.0	.....
48	1-cyl (Annihilator)	11.0	.....

tities of water at 160 to 180F and imposes throughout the washing period, highly fluctuating demands on the hot water storage supply. Because of these fluctuating demands, it is necessary or desirable to maintain a hot water storage of at least 4,000 to 6,000 gallons. Either an open or closed type heater may be used. Although the open type has been more generally employed, more recent practice favors the closed type.

If the hot water storage is separate from the heater, it is desirable to have a circulating pump. This pump takes its supply from the bottom of the storage tank and discharges it through the heater, an arrangement that maintains the storage supply at a practical uniform temperature. The tank level is maintained uniform by means of a float-operated valve which admits city water directly to the suction end of the pump so that the cold water is heated before it enters the tank.

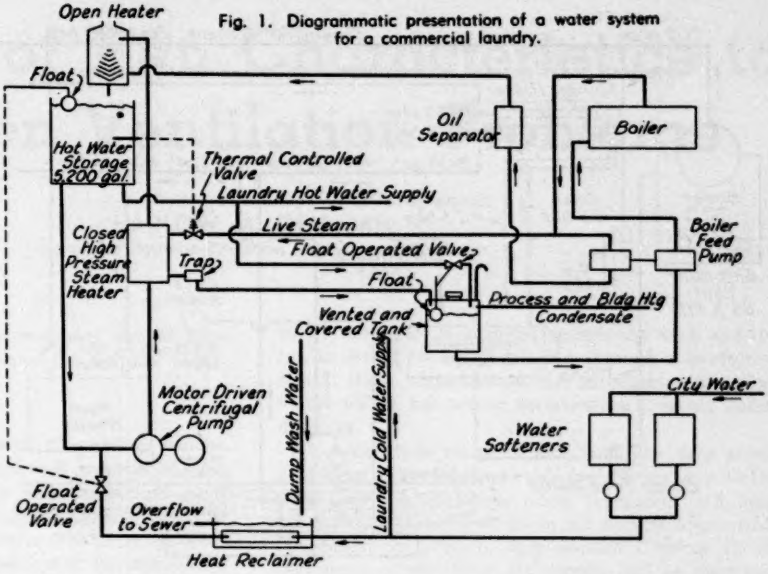


Fig. 1. Diagrammatic presentation of a water system for a commercial laundry.

The quantity of hot water used by commercial laundries varies partly because of the storage temperature maintained and partly due to the temperature of water used for the "break" (first washing operation). A good estimating figure for the amount of hot water required by an average commercial laundry is 65 gal per kwh of power usage. In the case of our assumed laundry with motors that use 7,200 kwh a month, the total hot wash water consumption would be approximately $12 \times 7{,}200 \times 65$, or about 5,600,000 gal a year.

Laundries that generate a major part of their electrical requirements usually have sufficient exhaust steam from their engines for heating water during regular working periods. However, after washing operations are finished and there is little need for hot water, an appreciable amount of exhaust steam is wasted to the atmosphere. A suitable arrangement should be provided to supply live steam to outside storage tanks because there is considerable drop in water temperature during non-operating periods, particularly over winter week-ends. Allowance should also be made for this factor when estimating total water heating steam needs of the laundry.

Fig. 1 illustrates the water system of a laundry that formerly generated its power and used an open type heater for boiler water and wash water supply. The closed type water heater, motor-driven circulating pump, thermal controlled steam valve and heat reclaimer were added as part of an improvement program coincidental with a changeover to complete purchased electric service.

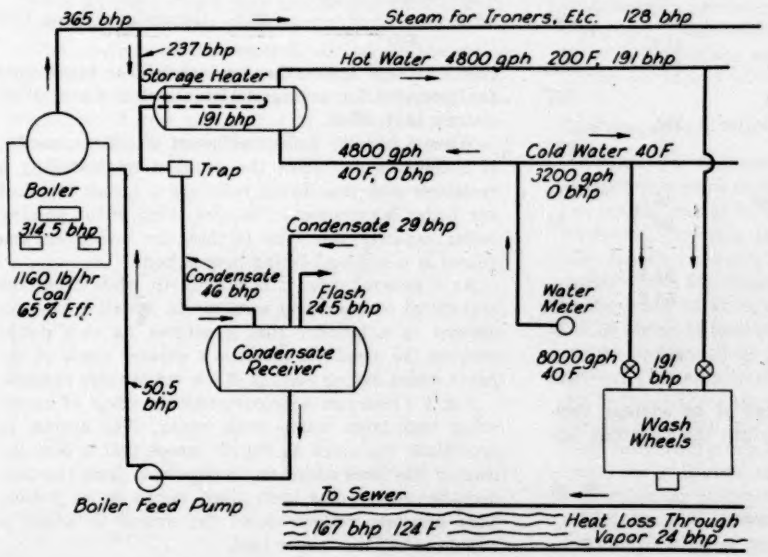


Fig. 2. Typical heat flow in a laundry without heat recovery.

Space Heating

In northern localities some space heating is required by laundries but as a rule it is confined mainly to the

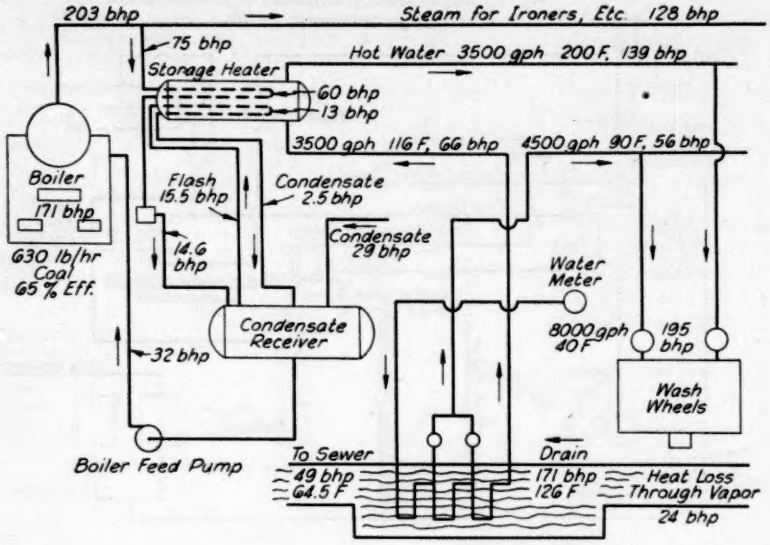


Fig. 3. Typical heat flow in a laundry with complete heat recovery.

office, receiving and shipping rooms. The annual steam required for space heating, usually does not exceed 3 to 5% of the total steam generated.

Heat Flow and Steam Distribution

Fig. 2 shows the approximate flow of heat in a typical commercial laundry that uses purchased electric service and where heat recovery is not employed. It will be noted that of the 314.5 boiler horsepower produced, over 50% is lost to the sewer in the medium of waste wash water. Taking the various heat components of the system in Fig. 2, the following results:

	Bhp	Total Bhp
To boiler: Fuel fired	314.5	
Condensate returned	50.5	365
From boiler: To water heater	237	
To ironers, etc.	128	365
To water heater: Steam input		237
From water heater: Hot wash water	191	
Condensate to receiver	46	237
To condensate receiver:		
Condensate from water heater	46	
Condensate from ironers	29	75
From condensate receiver:		
Flash to atmosphere	24.5	
Return to boiler	50.5	75
To washers:		191
From washers: To sewer	167	
Vapor (heat to clothes, etc.)	24	191

The total annual steam usage of an average commercial laundry divides itself into the following approximate percentages:

High pressure process	33 %
Water heating (no heat recovery)	50
Space heating	5
Boiler auxiliaries	8
Miscellaneous and losses	4
Total	100 %

Heat Reclaimers

The term "heat reclaimer" is used to describe a piece of equipment which many laundries have installed in recent years to recover a portion of the heat ordinarily lost to the sewer in waste wash water. A common type of reclaimer consists essentially of a pit into which waste water drains from the wash wheels. Placed in this pit is a bank of pipe coils through which city water passes on its way to the water heater. A properly designed reclaimer will ordinarily add about 40F to the temperature of incoming water and will thereby make a substantial reduction in the amount of steam required for water heating.

In Pittsburgh, Pa., the annual mean city water temperature is about 60F. Approximately 120 Btu are required to raise one pound of this water to 180F. A heat reclaimer ordinarily would preheat the incoming city water to a temperature of about 100F, thus making it necessary for the regular water heater to add only 80 Btu per pound to raise the water to 180F. The approximate saving in steam for water heating resulting from the use of a reclaimer would therefore be $\frac{(120 - 80) \times 100}{120} = 33\%$. Generally existing fuel prices make it imperative for laundries to investigate the prospects for savings which the use of a heat reclaimer may effect.

When a laundry finds itself short of boiler capacity, it sometimes can solve the problem by installing a reclaimer and thus bring relief at a rather low cost per boiler horsepower. The nice thing about gaining boiler capacity this way is that the investment required is a self-liquidating proposition.

As a general rule, it is not worth while from the standpoint of operating economy to install a heat reclaimer in a laundry that generates its own power because the usual net result is a greater waste of exhaust steam during periods of low wash water demand.

Fig. 3 illustrates approximately the effect of recovering heat from waste wash water. The system is essentially the same as Fig. 2 except that a heat reclaimer has been added and flash steam from the condensate receiver has been piped to the water heater. This diagram clearly shows the extent to which a reclaimer reduces boiler load.

Relation of Fan Characteristics to Common Ventilation Problems

HARLOW M. CHAPMAN
Industrial Hygiene Engineer, Bethlehem Steel Co.

A brief review of what the engineer should take into account in specifying fans for various industrial applications.

EVERYONE is familiar with air-moving devices. The principles are old and well established, and fans are manufactured for a wide variety of uses. However, every fan manufacturer publishes reams of data to accompany each product, and the broad purpose for which the fan was intended may be lost among pages of multi-rating tables. Each type of industrial fan was made to act under certain general conditions, and once the proper type is chosen, a knowledge of fan characteristics will allow the selection of fan size, speed and motor size to fit the specific conditions of air volume and resistance.

There are several basic types of fans familiar to all: propeller (wall type), centrifugal, and exial flow.

The most common is the wall-type propeller fan. This fan is used for general ventilation in rooms, or sections of rooms, where large volumes of air are to be moved against little or no resistance. For example, they may be used in work-rooms where the presence of a number of people requires a continuous flow of fresh air, in process ventilation where it is necessary to capture solvent vapor released to the air, or in the kitchen at home where they are used to remove cooking odors, grease and smoke.

The motor is most frequently directly connected to the fan, and therefore located within the air stream. The motor is thus cooled by the air stream, and also subjected to any contamination carried in the air. Consequently, a modified design is sometimes used where the motor is mounted outside the duct, and the fan is driven by a belt passing through a protective shield. Some accumulation can be expected to collect on the shield, but proper maintenance prevents undue difficulty.

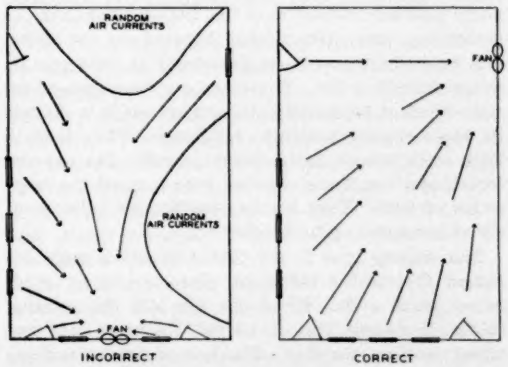


Fig. 1. Diagrams of correct and incorrect general ventilation.

Propeller fans range in size from the very small, providing a few hundred cubic feet per minute, to the very large which handle many thousands. All have the common inability to move air against appreciable resistance. In general, they require freedom of air movement, unrestricted air supply, and no duct system. Some propeller fans are mounted in short sections of duct, but caution must be used, since as little as ¼ inch wg resistance can be enough to prevent proper fan action.

The diagrams in Fig. 1 show the proper use of a wall fan. To provide satisfactory ventilation for all parts of a room, there must be freedom of flow. The air will travel directly toward the point of suction, and some parts of the room shown in the first diagram will not be as well ventilated as others if the fan location is not proper. In the second diagram, the fan is placed so that the air is drawn from the points of entry across all parts of the room, assuring a complete change of air throughout.

Several fans located in one room require special attention, in some cases, to obtain full benefit. If there is inadequate provision for air entry, a large fan may overpower a smaller fan and cause air to flow inward through the fan and against the rotation of the blades. Proper air supply will stop such reverse air flow.

Centrifugal Fans

Centrifugal fans are used in industry to move air against resistance as high as 20 to 30 inches wg. They are mainly useful in moving air through systems of ductwork. Locating the ducts where space is limited may require ingenuity, since the air must enter at the center of the fan wheel and be discharged tangentially to the wheel or at right angles in the inlet duct.

The motor is located outside the air stream, and so cannot be harmed by air-borne materials. The structure of the centrifugal fan can be made suitable for many industrial uses and consequently is seen in air conditioning and air heating systems, in removing high temperature air around furnaces, removing dust from dusty operations, such as grinding, screening and crushing, or removing corrosive mists from plating tanks, acid baths, etc., and is also used in pneumatic conveying of wood dust, wood blocks, grain and similar items.

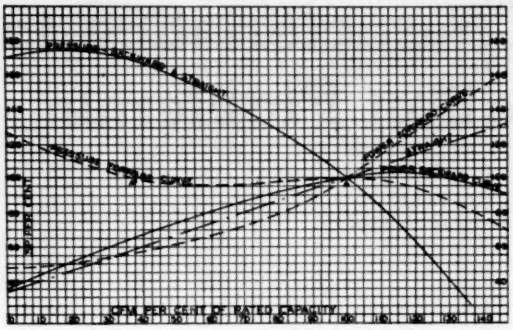


Fig. 2. Fan curves of forward, backward, and straight blade wheels compared.

The resistance to air flow within the system will vary according to the characteristics of that system, and the design factors include both cubic feet of air per minute and resistance (static pressure) in inches of water. Obviously, the fan is selected to provide the air necessary for that system, and the scroll or housing has been designed for the most efficient use of the air. However, the ability of the fan to provide air volume against resistance is governed largely by the type of wheel within the fan.

The three basic types of fan wheel differ in appearance of the fan blade: (a) the multi-vane or forward type (often called squirrel-cage), (b) the straight blade or paddle-wheel type, (c) the backward curve or backward inclined type.

The forward curve blade type is suited to handling large quantities of clean air in systems of moderate resistance. It operates at moderate speeds and is relatively quiet. It has an unstable resistance curve and consequently is not dependable for all systems. The curved blades (concave forward) tend to fill up and change characteristics in handling dirty air, and the volume of air will decrease.

The straight blade wheel is most common for heavy industrial work. This type has good pressure and air volume characteristics, and is often quite efficient. It is suited to material handling, and may have a backplate and flange for additional strength. The straight blades can handle material without accumulation or clogging, and are often made heavier to withstand abrasive action.

The backward curved blade, or backward inclined blade, has good pressure-volume characteristics and many industrial uses. It may be found in nearly all air-handling problems though perhaps not material handling. It is often used for forced and induced draft in boiler operation, etc. The main feature of the backward blade wheel is the limiting horsepower curve which will be discussed later.

Many of the fans will be equipped with extra features, such as inlet turning vanes which turn the air in the direction of the rotating wheel to prevent shock loss when the incoming air strikes the blades, and also variable dampers at the inlet for altering flow in the system.

Since the design of the blade has so important an effect on the volume of air provided, it is essential that the fan wheel be mounted properly. It is not uncommon to find faulty air flow in a system because the wheel was reversed during installation and has been running backward. Usually the wheel has a large arrow on the hub or flange indicating the direction in which it should be turning.

A comparison of the characteristics of the three types of wheel (Fig. 2) by means of the static pressure curves requires an understanding of the pressure curve. The manufacturer tests the fan by running it at a stated speed (rpm), altering the resistance (static pressure) a number of times, measuring the volume of air handled by the fan at each pressure and plotting the results. The data will plot as a curve, and all fans of similar type, regardless of size, have similarly shaped curves.

The forward curve wheel has a definite dip in its curve in the unstable region. If the fan is selected to operate at a pressure which has two possible air volumes, A and A^1 in Fig. 2, the air flow becomes erratic, since the fan is not constrained to operate only in one manner. Operating further to the right to avoid the unstable portion of the curve will usually require operating at a lower efficiency and increased power cost.

The forward curved blade wheel has a sharply rising horsepower curve. If the system is altered to allow more air, the load on the fan motor increases rapidly; and in the event of a broken duct or opened damper, the motor can become overloaded dangerously if not protected.

The straight blade wheel and backward blade wheel are similar in pressure-volume characteristics, and both curves have a smooth and uniform slope. Both can be selected to operate at good efficiency though it is often advisable, with certain types of fan, to select an operating position a little to the right of peak efficiency in order to operate at a steep part of the curve. If so, a change in pressure will then result in only a moderate change in air volume.

The straight blade wheel also has a rising horsepower curve, but the backward curve or inclined wheel has a drooping horsepower curve indicating that beyond a certain air volume, the horsepower tends to crease as more air is supplied by the fan. Consequently, there is a limit beyond which the motor load cannot go no matter how much air is admitted, and many fans are selected with this limiting factor in the design as a precaution against burning out the motor.

A type of fan seen more frequently as time goes on is the axial flow fan. These are propeller fans of design different from wall fans, and are made to operate in ducts against moderate resistance. They tend to fill a much needed gap between propeller fan use and centrifugal fan use, since they have some of the properties of both. They handle considerable volumes of air at pressures up to 4 inches wg.

The simpler type is the tubeaxial and a more advanced type is the vaneaxial, characterized by guide vanes which either direct the air into the rotating blades or receive the air at the discharge side and direct it down the duct. The low pressure resulting from low linear velocity of the base of the blade as

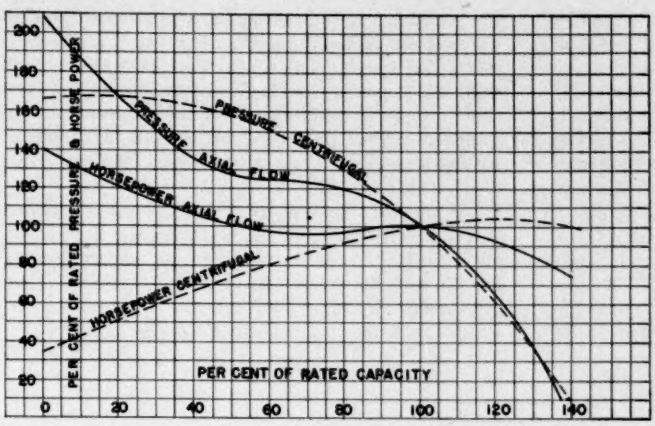


Fig. 3. Curves for centrifugal and axial flow fans compared.
Courtesy Buffalo Forge Company

compared to high pressure and high speed at the blade tip make it necessary to fill in the propeller fan hub before useful pressures can be created. Axial flow fans are distinguished by large hubs (50%-70% of the diameter) and relatively short, thick blades of airfoil design.

The pitch of the blades changes the appearance of the pressure curve, especially with regard to the dip in the curve (Fig. 3). The flat, low angle blades have a fairly steep curve without a serious dip, but as the pitch increases, the dip becomes appreciable as in the forward curved centrifugal fan. However, a difference exists in that the axial flow fan peak efficiency lies well toward free delivery on the right side of the curve. When the axial flow fan is selected to the right to avoid the unstable region of the curve, it approaches the zone of best efficiency.

Axial flow fan curves are interesting, compared to centrifugal fans. The pressure curves are relatively steep, and the horsepower curves slope in a manner opposite to the centrifugal type. Apparently the centrifugal fan requires more power with additional air, while the axial flow requires more power with additional pressure.

A big feature of this type is the compactness of the fan and the fact that it can be placed in the duct without requiring extra space. They are often said to be noisy, but, generally speaking, they are comparable in noise level to centrifugal fans when operating at moderate pressures.

The fan laws govern the basic relation of fans of the same type. When a particular style or type has been designed, larger and smaller sizes are related by definite proportions in all significant dimensions. Consequently, when one size is tested under a certain set of conditions, the resulting data can be applied to other sizes and other conditions when corrected by a proper ratio. The relation of sizes and means of testing have been closely governed by the National Association of Fan Manufacturers.

The most commonly encountered form of the fan laws states: (1) cfm α rpm, (2) SP α $(\text{rpm})^2$, and (3) hp α $(\text{rpm})^3$. This means that the rpm at which the fan rotates is a measure of the operation of that fan. If the cfm, static pressure, rpm, and horsepower are known for one point of rating, at a new rpm a new fan rating can be found. That is, the new cfm, new SP, and new hp can be calculated.

Suppose a ventilation system requires more air, and all dampers and other restrictions have been removed and design is at its best. The fan may then be called upon for more air. First, determine the rpm, cfm, SP and horsepower of the present conditions of operation. Next, determine the quantity of air desired, and compute by (1) the new rpm from the ratio of the air volumes. Then compute the new horsepower by (3) from the relation of the rpm's to be sure the fan motor will not be overloaded. With a change of pulleys, the fan can be speeded and the new fan rating will be attained. The new static pressure will be found to be as predicted by (2).

One note of warning: if the fan is to be speeded by a considerable amount, it will be necessary to refer to published data to see if the new fan speed exceeds the maximum safe speed for that fan. Unless otherwise informed, it is prudent to be guided by speeds listed in the multi-rating tables as they are known to be well below the destruction limits.

Using these relationships, curves were calculated for 1000 rpm and 1100 rpm (Fig. 4) from a hypothetical fan curve at 900 rpm. Eight points were

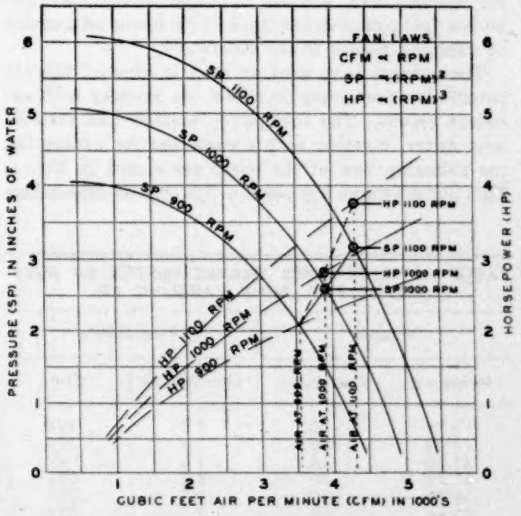


Fig. 4. Fan curves illustrating application of the fan laws.

selected at roughly equal intervals across the length of the 900 rpm SP curve, and the cfm and SP noted at each point. The same was done for the hp curve. An equivalent point at 1000 rpm was then calculated for each selected point, by means of (1), (2) and (3), from the ratio of the new rpm to the old rpm. The eight new points of the pressure curve at 1000 rpm were located by plotting the new values of cfm and SP, and the hp curve at 1000 rpm was obtained in like manner by plotting the new values of cfm and hp.

It is important to realize from (1), (2) and (3) that the increased rpm necessary to provide a relatively little additional air will demand much additional power. To show that rate of increase, the two scales for pressure and horsepower have been made identical which is not likely in practice. However, it can be seen that at 900 rpm they are equal. When increased to 1000 rpm, the power is climbing more rapidly and at 1100 rpm, the power greatly exceeds the pressure for the same air, and yet the air volume increase, as shown by advancement along the horizontal axis, has been relatively little.

The fan laws have many forms and can be applied in many ways, but any successful system design can be carried out only by knowing the capabilities of the fan and the requirements of the fan laws. They are equally helpful in pointing out the advantages of revision, and the costs and disadvantages involved.

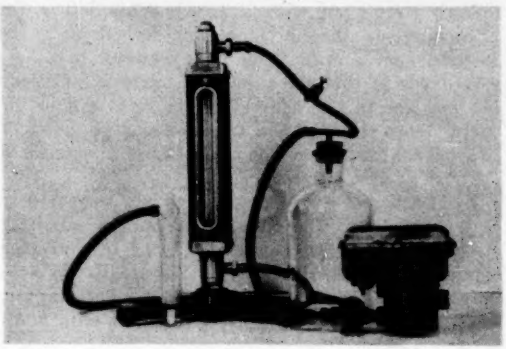
Fuel Pump for Air Sampling

H. G. BOURNE, Jr. and R. D. SCHAFER
Ohio Department of Health, Columbus, Ohio

CHEMISTS and industrial hygienists occasionally find it necessary to sample air in crane cabs, along "catwalks" or out-of-doors where the conventional electric supply is not available and portability of equipment is of prime importance. The necessary apparatus usually consists of a vacuum pump, midget fritted glass bubbler or impinger, and a flow metering device.

A midget pump having the necessary portability characteristics, but depending upon a source of 110 volts a-c, has been described by Bourne in the *Industrial Hygiene Newsletter*, August, 1947. Cosens and Gloyna suggest in the *Industrial Hygiene Newsletter* for March, 1949, the use of three mechanical automobile fuel pumps driven by a ¼-hp motor as a means of pumping liquids in the laboratory.

The authors have used an electric Stewart Warner automotive fuel pump to collect air samples with excellent results. The fuel pump, bubbler and variable area meter, together with a container for dampening the pulsating flow of the pump are shown in Fig. 1. This pump weighs 3½ pounds. Its over-all dimensions



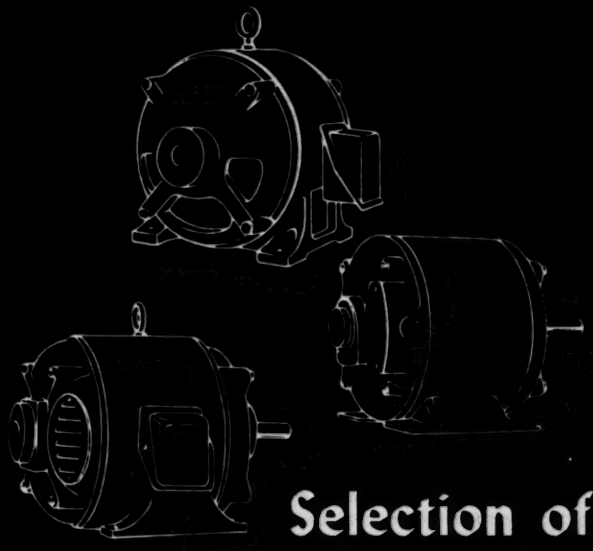
are 5 x 5 x 7 inches and it can be operated directly from a 6-volt storage battery. Since the current drain at full load is only 2 amperes, an extended sampling time is possible without battery recharging.

The performance characteristics of this pump are shown in Table 1.

The small fritted glass bubbler commonly used in industrial hygiene work requires approximately 20 cm. (7.88 inches) of water vacuum to produce an air flow through the bubbler of 1 liter (0.353 cu ft) per minute. It may be seen from Table 1 that this flow can be easily accomplished using the pump described; in fact, two or even three bubblers in series may be used effectively. The midget impinger, however, necessitates a vacuum of 30.5 cm. (12.02 inches) of water to produce a flow of 2.83 liters (0.1 cu ft) per minute. Thus, it has been found necessary to use two pumps in parallel in order to operate this device.

TABLE 1—PERFORMANCE CHARACTERISTICS OF AUTOMOTIVE FUEL PUMP HANDLING AIR.

Vacuum		Rate of Flow	
Inches w.g.	Cm. Water	Liter/Minute	Cfm
3.94	10	3.5	.124
7.88	20	3.1	.109
11.82	30	2.8	.099
15.76	40	2.5	.088
19.70	50	2.3	.081
23.64	60	2.1	.074
27.58	70	1.9	.067



Selection of Induction Motors for Air Conditioning, Heating, and Ventilating Equipment

GEORGE NAFE

Manager, Sales Service Section, Century Electric Co., St. Louis, Mo.

Heating and Ventilating Magazine's Reference Section

Selection of Induction Motors

for Air Conditioning, Heating and Ventilating Equipment

GEORGE NAFE
Manager, Sales Service Section, Century Electric Co.
St. Louis, Mo.

Proper motor selection is dependent on many factors—suitable installation, torque requirements of the equipment to be driven, and electrical characteristics and mechanical construction of the motors themselves. Data are given to cover the more popular types of induction motors used to drive heating, ventilating and air conditioning apparatus.

MUCH of the heating and ventilating equipment in use today requires electric motors. This has not always been so, but it developed only after the motor became versatile and more motor types were available. The proper application of these various types soon made it possible to control the flow of air for human comfort. Now, heating and ventilation are associated largely because of the wide acceptance of this dependable machine called the motor.

SINGLE PHASE MOTORS

Single phase motors make up a large percentage of all motors used in the heating, ventilating and air conditioning industry. Since the current in a single phase circuit does not produce a rotating magnetic field, special devices are necessary to enable single phase motors to start. This makes the single phase motor more complicated than a polyphase motor, and more susceptible to trouble when installed. Furthermore, the power factor and efficiency of the single phase motor are lower than those of a polyphase motor of the same output. For these reasons single phase motors are used only in the smaller sizes, or where polyphase power is not available. The most popular types of single phase induction motors will be discussed.

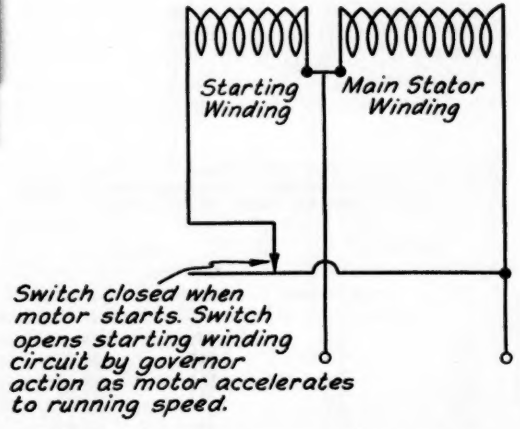

Starting Winding
Main Stator Winding
Switch closed when motor starts. Switch opens starting winding circuit by governor action as motor accelerates to running speed.

Fig. 1. Diagram of a resistance split phase motor.

Split Phase Motors

The resistance split phase motor is the most common of all fractional horsepower single phase induction motors. It is the lowest in cost, and is capable of handling many of the more common heating and ventilating applications.

The essential parts of this motor are shown schematically in Fig. 1. The split phase motor depends on a phase or auxiliary winding in order to obtain starting torque. This phase winding is made of fine wire having a relatively high resistance, and hence a high power factor. The main winding is made of heavier wire having a lower resistance and higher reactance than the phase winding. This causes a displacement between the current in the main and phase winding, and results in a rotating magnetic field. When a predetermined speed is reached, usually around 70% of full load speed, a centrifugal device opens a switch in series with the phase winding. With the phase winding removed from the circuit, the motor draws current in the main winding only, and operates as a single phase squirrel cage induction motor.

The speed-torque curve of an average fractional horsepower split phase motor is shown in Fig. 2. The locked rotor torque is usually about 150% of full load torque, while the pull-up torque is around 135% of full load torque. The breakdown torque is in the neighborhood of 200% of full load torque.

The amount of torque required to handle a given load must be carefully considered when motors of this type are being applied. If the motor is not able to bring the load up to speed rapidly, the phase winding will remain in the circuit too long, and overheating or motor burn-out will result.

The amount of accelerating torque required is determined to a great extent by the WR^2 or inertia involved. The inertia of the load should always be kept in mind when selecting motors. Split phase motors are to be used only on applications that are easy to start and can be brought up to speed rapidly. A large WR^2 may dictate the use of another type motor.

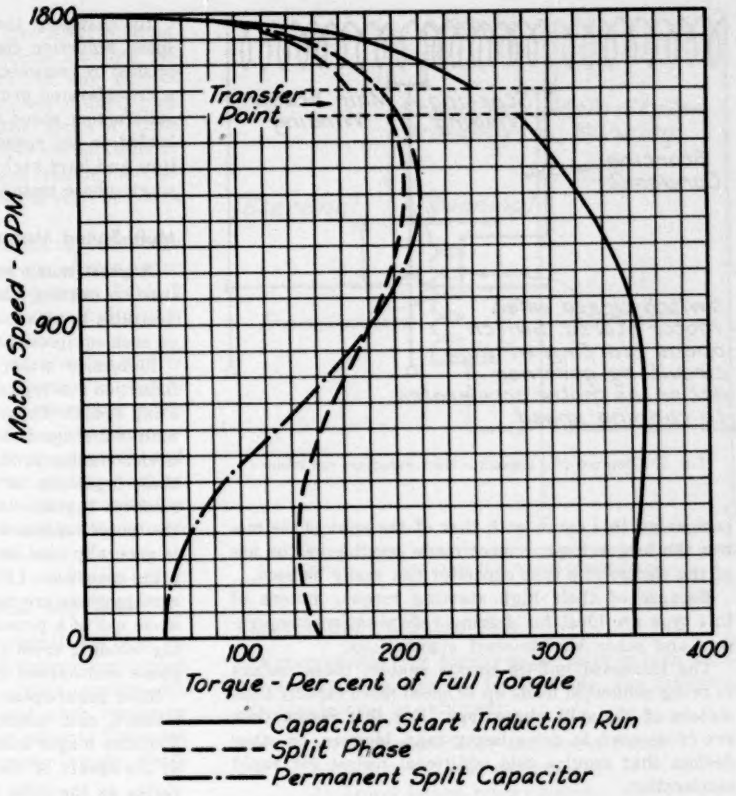


Fig. 2. Speed-torque curves of single phase fractional horsepower motors.

These motors are widely used in fans, blowers, oil burners, and many other heating and ventilating applications. Motors of this type have a low starting torque, draw a relatively high starting current, and for these reasons are usually limited in size to 1/3 hp or less, except on special applications where it is sometimes possible to engineer a motor for a specific job.

The split phase motor just described is referred to as the general purpose split phase motor. Another type of split phase motor, called the special service split phase motor, is sometimes used in heating, ventilating and air conditioning work, although it is not ordinarily recommended for these applications or other services that require frequent starting. These special service motors draw starting currents that are high enough to produce light flicker, and are normally used on washing machines, ironers, and other types of equipment that do not require frequent starting.

TABLE 1—STARTING CURRENT FOR FRACTIONAL HORSEPOWER MOTORS.

Rated HP	Locked Rotor Current in Amperes	
	115 Volts	230 Volts
1/6 and smaller	20	10.0
1/4	23	11.5
1/3	31	15.5
1/2	45	22.5
3/4	61	30.5

Capacitor-Start Induction Run Motors

The development of reliable, low-cost electrolytic capacitors made the capacitor-start induction run motor possible. As soon as these capacitors became available, motors of this type were developed and today they are widely used on many applications.

The capacitor-start induction run motor is a type of split phase motor with improved starting characteristics. The schematic diagram is shown in Fig. 3. This motor differs from the resistance split phase motor in that a capacitor is placed in series with the phase winding. Displacement between the current in the main and phase winding is increased, since the addition of a capacitor to the phase circuit greatly improves the displacement. This greater displacement makes increased starting and pull-up torques possible. Some type of centrifugal device is usually employed to open a switch in series with the phase circuit after a predetermined speed has been reached, to remove the starting winding and capacitor from the circuit.

The speed-torque curve of an average fractional horsepower motor of this type is shown in Fig. 2. By

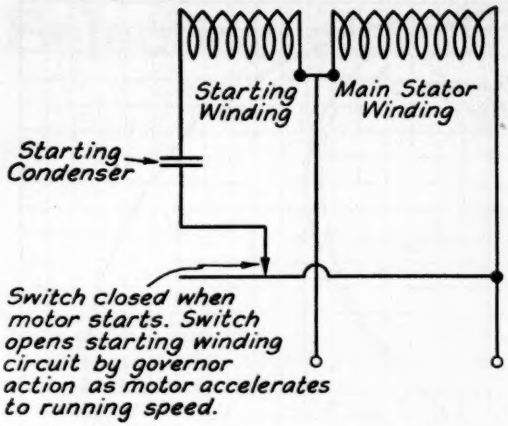

Starting Winding
Main Stator Winding
Starting Condenser
Switch closed when motor starts. Switch opens starting winding circuit by governor action as motor accelerates to running speed.

Fig. 3. Diagram of a capacitor-start induction run motor.

comparing this curve with that of the split phase motor, the torque improvement made possible by the use of the electrolytic type capacitor can easily be seen.

Because of their high starting torque, motors of this type are ideal for driving refrigeration compressors and other hard-to-start applications.

The increased pull-up torque enables these motors to bring connected loads up to speed more rapidly than motors of the split phase type. For this reason they are often used to drive heavy fans, blowers, or other devices that require this additional torque for rapid acceleration.

All fractional horsepower motors of this type are designed to have starting current not to exceed the values listed in Table 1. These motors are regularly used to drive equipment where motors larger than 1/3 hp are required, since the split phase motor is not normally available in these higher horsepowers.

Permanent Split Capacitor Motors

Motors of this type are used widely on fan and blower applications where the fan or blower can be either directly connected to the motor, or mounted on the motor shaft. They are ideal for operating unit heaters or unit coolers.

Both the main and phase windings are designed so that they can remain in a circuit at all times. An oil-filled capacitor is placed in series with the phase winding, since capacitors of this type are capable of remaining in the circuit continuously. Therefore, it is not necessary to open the phase circuit on motors of this construction, and starting switches, centrifugal devices, etc., can be eliminated. This results in a simpler and more trouble-free motor.

The starting torques developed by these motors are necessarily low. This torque is in the neighborhood of 40 to 50% of full load torque. The speed-torque curve of a typical permanent split capacitor motor is shown in Fig. 2. Because of torque limitations these motors are not recommended for belt-driven applications or other applications requiring considerable starting or pull-up torque.

By changing the voltage applied to these motors, speed reduction can be obtained. This can be accomplished by reconnecting the motor winding, or by using a transformer providing varying voltage. To obtain satisfactory speed reduction, the motor should be fully loaded on top speed. These motors are quiet in operation, and have higher efficiency and power factors than single phase motors of other types.

Multi-Speed Motors

A great many multi-speed single phase motors are used on heating and ventilating equipment. It is often desirable to make use of two or more operating speeds on such equipment as window fans and unit ventilators.

Motors of either the split phase or capacitor-start induction run type may be constructed to give two operating speeds. These motors ordinarily make use of two main windings and two phase windings. A centrifugal device similar to those used on single speed motors of these types can be employed to operate a switch that removes the starting winding from the circuit after the motor reaches a predetermined speed. This method is generally used on multi-speed motors when the operating speeds are 1,800 and 1,200 rpm. When other speed combinations are desired, it is sometimes necessary to make use of a potential type relay to remove the starting winding from the circuit. The majority of single phase multi-speed motors are 1,800/1,200 rpm.

Most multi-speed motors are used to drive fans or blowers, and, hence, are of the variable torque type. Variable torque motors develop horsepowers that vary as the square of the speed. Since a fan or blower load varies as the cube of the speed, motors of this type handle these applications very satisfactorily.

Some types of multi-speed single phase motors are designed to handle only lightweight fans and blowers, i.e., equipment that requires limited starting and accelerating torques. These motors should only be applied where the load can be easily started and brought up to speed rapidly.

Repulsion-Start Induction Run Motors

This type of single phase motor finds a wide field of application in the refrigeration and air conditioning industry, not only in fractional horsepower sizes, but also in integral sizes sometimes as large as 10 hp.

The repulsion-start induction run motor starts as a repulsion motor and runs as an induction motor. It has a distributed winding in the stator, and a rotor that is built like that of a direct current motor. The rotor winding is connected to a commutator. When the brushes are short-circuited by connecting them together, and are set in the correct position, this motor is capable of developing a very high starting torque. A centrifugal device is provided that connects all the commutator bars together at a predetermined speed, thereby converting the armature to a squirrel cage rotor. This is essential if the motor is to have constant speed characteristics, since a drooping speed torque curve would result if operated continuously as an induction motor. By short-circuiting the commutator at the proper time, it is possible to obtain the high starting torque of the repulsion motor and the constant speed

characteristics of the squirrel cage type while running.

Motors of this type have the highest starting efficiency (starting torque per ampere) of any type of single phase motor. They are also capable of developing a higher starting torque than the other types of single phase motors described. These features are particularly important on some applications, and should be considered when the driven load is harder to start or where low voltage is likely to occur.

It might be well to point out the effect of low voltage on starting torque. The starting torque of any motor varies as the square of the applied voltage. Table 2 shows the effects low voltage has on the ability of a motor to start a load.

This low voltage does not affect the starting ability of motors of this type to as great an extent as it does the other types of single phase motors described in the article for: (1) these motors draw less starting current, and hence do not lower the voltage as much, and (2) which is just as important, is the greater starting torque that is available. Even when these motors are operated at reduced voltages, sufficient starting torque is often available to handle the load.

INTEGRAL HP SINGLE PHASE MOTORS

The majority of motors larger than 5 hp used on heating, ventilating and air conditioning equipment are polyphase. However, single phase motors are regularly used in sizes up to 5 hp and when necessary can be obtained in larger horsepower ratings. The most popular types of integral horsepower single phase motors will be described.

Capacitor-Start Induction Run

These motors are built regularly in sizes up to 5 hp. The construction and operating characteristics are basically the same as those of the fractional horsepower capacitor-start induction run motors described. In some sizes and speeds, centrifugal switches do not give satisfactory service, and voltage sensitive relays are employed to remove the phase circuit from the line.

Torques of the following values may be expected from these motors:

250 to 300%, starting torque; 225%, pull-up torque; and 200%, breakdown torque. Speed torque curves are fundamentally the same as those of the fractional horsepower ratings.

TABLE 2—EFFECT OF LOW VOLTAGE ON LOCKED ROTOR TORQUE.

Per Cent Voltage Drop		Per Cent Effective Torque
0	=	100
5	=	90.25
10	=	81.00
15	=	72.25
20	=	64.00
25	=	56.3

Torque changes as the square of the applied voltage.

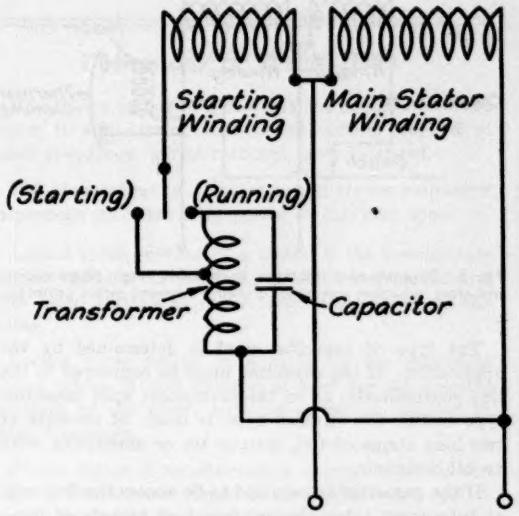


Fig. 4. Diagram of a capacitor-start capacitor-run motor using a single oil-filled capacitor and autotransformer.

Capacitor-Start Capacitor-Run

Motors of this type employ capacitance in both starting and running circuits. By so doing, the following advantages may be obtained:

(1) Higher efficiency and power factor
(2) Lower full load current
(3) Lower locked rotor current

Some designs make use of electrolytic capacitors in the phase circuit in parallel with oil-filled capacitors. When the motor reaches a predetermined speed, the electrolytic condenser is removed from the line. After this takes place, the oil-filled capacitor remains in the phase circuit. A similar effect can be obtained by using an oil-filled capacitor with an autotransformer across the capacitor terminals, as shown in Fig. 4.

By using the autotransformer in this manner the voltage across the capacitor can be increased, and is often doubled. Doubling the voltage applied to a capacitor increases the capacitor effect four times, resulting in high starting torque.

The cost of such motors is necessarily higher than that of capacitor-start induction run type motors. In many cases heavier wire must be used in the phase winding, and the addition of oil-filled capacitors or autotransformers add to the cost. In some sizes it is necessary to use motors of this type to meet established starting current limits.

Capacitors Used on Single Phase Motors

Capacitors used on capacitor type single phase motors have certain limitations. Unsatisfactory motor service and performance can often be avoided if these limitations are kept in mind.

Any capacitor has three essential parts, two of which are usually metal plates separated and insulated by the third part, called the dielectric.

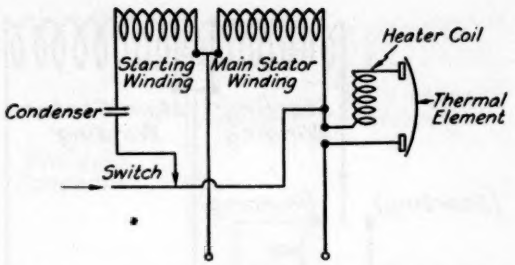


Fig. 5. Diagram of a fractional horsepower single phase capacitor-start induction run motor showing inherent motor protector.

The type of capacitor used is determined by the application. If the capacitor must be connected to the line continuously, as in the permanent split capacitor type motor, the oil-filled type is used. It consists of two long strips of foil, usually tin or aluminum, with an oil dielectric.

If the capacitor is required to be across the line only at infrequent intervals and for short periods of time, as in capacitor-start induction run motors, an electrolytic type is ordinarily used.

Capacitors of this type differ from other types in that one of its conducting surfaces is a metallic plate, the other being a chemical compound or electrolyte. The dielectric employed is a thin film of oxide of the metal which constitutes the metallic plate used in the structure. The characteristics of capacitors are affected by temperature variations, and this should be kept in mind when capacitor type motors are subjected to unusual ambient temperatures.

The usual low temperature limits observed in applying electrolytic capacitors lies between 10F and 0F. At these temperatures, capacity may be off about 15%. Starting and pull-up torques would be decreased in slightly greater percentages. At —10F, capacity may be decreased as much as 40%. High ambient temperatures also limit the effectiveness of electrolytic capacitors. Capacitors of this type should not be installed in an ambient temperature higher than 165F.

Oil-filled capacitors are affected by low temperature in a similar manner to the electrolytic types. At —10F, the capacity will not decrease more than 10 to 15%. The capacitor is not permanently damaged by low temperature. Capacitors of the oil-filled type should not be operated in ambients above 125F, unless the application receives special consideration. This usually results in the use of special capacitors. This temperature is necessarily low, due to the internal losses of these capacitors. Oil-filled capacitors are usually applied where continuous capacitor operation is required, and capacitor losses are present at all times. These losses must be considered when establishing safe ambient temperatures.

Because of the temperature limitations mentioned, it is sometimes necessary to mount capacitors separate from the motor. Therefore, they can often be placed in normal ambient locations. Some manufacturers place a baked finish on their product after the motor has been installed. When capacitor motors are put through baking ovens, the baking temperature should not exceed 150F. The requirements of special applications should always be carefully studied. Some applications require the use of special capacitors.

Service Factor

General purpose fractional horsepower motors of the open type are rated on the basis of 40C (104F) temperature rise under continuous duty. This low limiting temperature rise is provided to allow a greater factor of safety where the service conditions are unknown.

This is a lower temperature rise rating than that for certain motors designed for specific duty and load conditions which are rated 50C or 122F (open); 55C or 131F (totally enclosed). These temperature rises are recognized as the maximum compatible with long insulation life.

Where open 40C general purpose fractional horsepower motors are used on specific applications and load conditions are known, it is recognized that these motors may be safely operated continuously at loads greater than that shown on the nameplate. The amount by which they may be overloaded (service factor) is that which will give a total temperature rise of 50C on these 40C open rated motors. The service factor is a multiplier which may be applied to the normal horsepower rating indicated on the nameplate. These service factors are listed in Table 3. These multipliers are to be used only when the motors are operated on rated voltage and frequency and in an ambient temperature not exceeding 40C. Only general purpose motors of the open type carry service factors.

Inherent Motor Protective Devices

Many motors, especially motors of the single phase type, are protected against injurious overheating by the use of built-in motor protective devices.

These devices make use of a bimetal disc or strip to open the motor circuit should the motor temperature become dangerously high. This disc or strip is made up of two metals having different coefficients of expansion. When the bimetal is heated one of these metals expands faster than the other, causing the disc or strip to bend. This, in turn, opens a contact and the motor is removed from the line. A popular type of inherent motor protector and how it is connected to a single phase motor circuit is shown in Fig. 5.

TABLE 3—SERVICE FACTORS FOR FRACTIONAL HORSEPOWER MOTORS.

HP	Service Factor for General Purpose 40C. Induction Motors
1/20	1.4
1/12	1.4
1/8	1.4
1/6	1.35
1/4	1.35
1/3	1.35
1/2	1.25
3/4	1.25
1 (at 3,600 rpm only)	1.25

The protector is mounted where its ambient bears a direct relationship to the motor temperature, and is connected in series with the motor current. This enables the device to protect against high motor temperatures or excessive current flowing in the motor circuit. Thus, any motor equipped with such a device would be protected against overloading, high ambient temperature, poor motor ventilation, stalled rotor conditions, etc.

These protectors are usually available in both automatic and manual types. On some applications, such as oil burners and stokers, manual protectors are provided. When the manual protector removes a motor from the circuit, the motor will not start until the protector is reset. The use of manual protectors prevents the motor from cycling, and enables an investigation of the trouble causing the protector to operate, before the motor is restarted.

These devices are becoming increasingly popular, and most of the single phase motors used in the heating and ventilating industry are so equipped.

POLYPHASE MOTORS

Many types of polyphase motors have been developed. The variety of polyphase motor applications make a great many types and designs necessary. The polyphase motors commonly used in heating, ventilating and air conditioning equipment will be dscussed.

Squirrel Cage Motors

Simplest and most rugged of all motors is the polyphase squirrel cage motor. It is lowest in cost, highest in efficiency, and easiest to maintain. Since polyphase circuits produce rotating magnetic fields, these motors are self starters. They obtain starting torque from the rotating magnetic fields, and do not require any auxiliary devices to produce a starting torque. This, of course, means that centrifugal devices, starting switches, brush mechanisms or commutators, are not required, and the elimination of all starting mechanisms makes these motors much simpler and easier to maintain than the various types of single phase motors described.

TABLE 4—LOCKED ROTOR CURRENT OF 3-PHASE, 60-CYCLE MOTORS AT 220 VOLTS.

HP	Design B, C and D	
	Amperes	Code
1 and less	24/hp	M
1½	35	L
2	45	K
3	60	J
5	90	H
7½	120	G
10	150	G
15	220	F
20	290	F
25	365	F
30 to 200	14.5/hp	F
	Design F	
30 to 200	9/hp	A

Definitions of Terms Used

Breakdown torque of a motor is the maximum torque which it will develop with rated voltage applied at rated frequency, without abrupt drop in speed.

Full load torque of a motor is the torque necessary to produce its rated horsepower at full load speed.

Locked rotor current of a motor is the steady-state current taken from the line with the rotor locked and with rated voltage at rated frequency applied to the motor.

Locked rotor torque of a motor is the minimum torque which it will develop at rest for all angular positions of the rotor, with rated voltage applied at rated frequency.

Power factor of an alternating current motor is the ratio of the kilowatt input to the KVA input, and is usually expressed as a percentage.

Pull-up torque of an alternating current motor is the minimum torque developed by the motor during the period of acceleration from rest to the speed at which the breakdown torque occurs. For motors which do not have a definite breakdown torque, the pull-up torque is the minimum torque developed up to rated speed.

**Slip of a motor* is the relation of synchronous speed to full load speed. It can be calculated with the formula $S = N_s - N/N_s$ where S = slip, N_s = synchronous speed and N = full load speed.

**Torque*, or moment of force, is the effectiveness to produce rotation about an axis.

*Definitions, with the exception of the ones marked with an asterisk (*), are from the standards of the National Association of Electrical Manufacturers.

A squirrel cage stator contains a distributed polyphase winding, while the rotor consists of slotted laminations with uninsulated copper or aluminum bars short-circuited at each end of the rotor.

These motors are made in various designs to be suitable for the many applications to which they may be applied. Each design is defined by NEMA (National Electrical Manufacturers Association) in terms of horsepower, speed, breakdown torque, starting torque, starting current, and slip. This method of evaluating motor performance insures intelligent design and proper application of motors of the squirrel cage type.

NEMA places polyphase motors of the squirrel cage type in five classes; designs *A*, *B*, *C*, *D*, and *F*. In this article are discussed only the types of motors that are used regularly on heating, ventilating and air conditioning applications.

The polyphase squirrel cage motor classified by NEMA as the design *B* motor is the most widely used squirrel cage motor. Motors of this design are capable of withstanding full voltage starting and have a slip at rated load of less than 5%. These motors develop

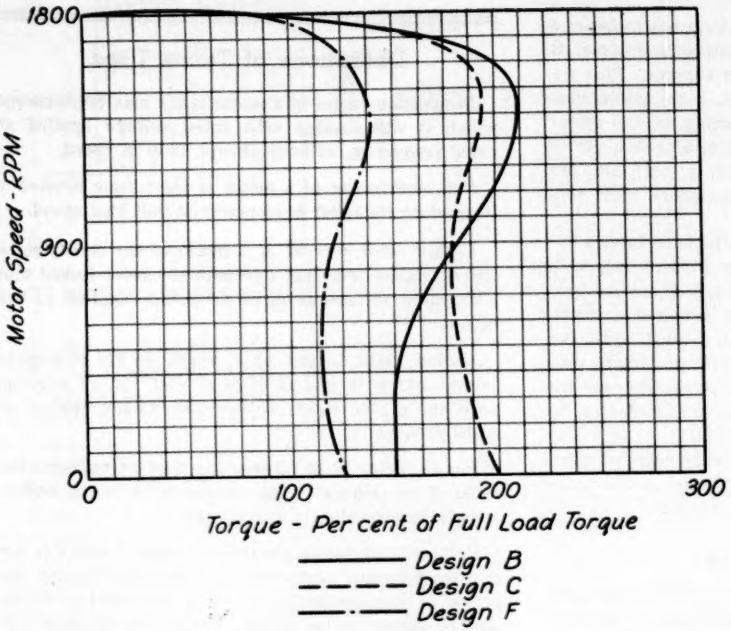


Fig. 6. Speed-torque curves of polyphase squirrel cage induction motors.

locked rotor and breakdown torque adequate for general applications. The majority of heating and ventilating applications can be satisfactorily handled by motors of this design. These motors will accelerate to full speed any load that the motor can start. The speed-torque curve of a typical motor is shown in Fig. 6.

The locked rotor currents should not exceed the values shown in Table 4. The code letters in this table are NEMA nameplate markings to show the kva per horsepower. For example, code letter *F* indicates a rating of 5.0 to 5.6 kva per hp. Notice that the starting current of motors from 30 to 200 hp should not exceed 14.5 amperes per horsepower at 220 volts.

The NEMA design *C* motor is constructed to handle applications that require higher starting torques than those furnished by the design *B* motor. Motors of this design make use of double cage rotors. The inner cage has a low resistance and high reactance, while the outer cage is constructed to have a high resistance and low reactance. During the starting period the greater portion is carried in the outer cage, and this enables a high starting torque to be developed. As the motor accelerates, current shifts to the low resistance inner cage. The breakdown torques available from motors of this design are slightly less than those of the design *B* motor. These motors will withstand full voltage starting, and have locked rotor currents the same as those of the design *B* motors. The speed torque curve of an average design *C* motor is shown in Fig. 6. These motors are commonly known as high-starting torque normal-starting current motors. Their most popular use is on refrigeration compressors that are not unloaded during the starting period.

The NEMA design *F* motor is a low-starting current low-starting torque motor that can sometimes be used on applications requiring limited locked rotor current. It is often possible to use motors of this design to meet certain power company regulations as to allowable motor starting current, and thereby avoid high cost motor control that would have to be employed with polyphase motors of other designs. Motors of this design are generally available only in from 30 to 200 hp, since this is the range that usually causes difficulty due to excessive starting current. The starting current in these sizes is 9 amperes per horsepower at 220 volts. To obtain a motor with this low-starting current, motor torques must be sacrificed; therefore, the starting and breakdown torques are low. Because of these limited torques, such motors should only be used on applications that start easily and can be brought up to speed rapidly. Blowers, fans and compressors equipped with unloaders can often be handled nicely by design *F* motors.

Increment Starting or Part Winding Starting

Any polyphase motor with a two-section winding can be used on increment starting if the proper motor leads are made available. Starters of this type energize one section of the winding at the time the motor circuit is closed. After a predetermined period of time elapses, the remaining section is placed in the circuit. This is accomplished by the use of a starter consisting of two sets of contacts and a timer. One set of contacts is closed, feeding part of the motor winding, and, after action of the time delay relay, the other set of contactors close completing the circuit to the full motor winding. By use of this combination it is possible to obtain approximately 48% of the locked rotor torque while drawing only 60% of full voltage locked rotor amperes.

Most power companies impose limitations on the current drawn during motor starting periods. While

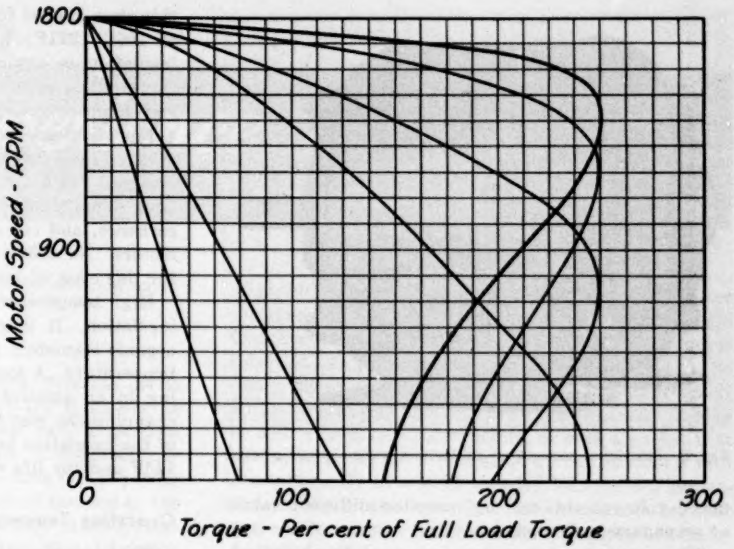


Fig. 7. Speed-torque curves of wound rotor polyphase motor with secondary resistance.

these limits vary, the limitations sometimes are such that the maximum increment of current during the starting period is all that must be fulfilled. In such cases a motor and starter combination as described can be used to meet these rulings. This results in a lower cost installation, since the use of an expensive motor control is avoided.

Multi-Speed Motors

Multi-speed squirrel cage motors find a wide variety of uses in the heating, ventilating and air conditioning fields.

Two, three or four different speeds can be economically obtained by the use of these motors. Two-speed squirrel cage motors have either a single winding or two windings in the stator.

Single-winding motors obtain the second speed by reconnection of the stator poles. Such motors produce only speeds in the ratio of two to one. Two windings are always required if the desired speeds are not in two-to-one ratio.

Most three-speed motors are built with two windings. The two speeds produced by one winding must be in the ratio of two to one. Three-speed three-winding motors are not usually recommended due to the large amount of space needed for the winding. Large frame sizes would be required, and this would result in very high cost motors. Only a limited number of speed combinations are available in four-speed motors. They nearly always consist of two windings, each of the reconnectible type.

There are three types of multi-speed squirrel cage motors available. These are referred to as constant torque, variable torque, and constant horsepower. Only constant torque and variable torque motors are commonly used in the fields of applications discussed.

Constant torque motors produce close to the same starting and breakdown torque at all speeds. Since horsepower is proportional to torque, the horsepower developed varies directly as the speed. Multi-speed motors of this type are used on applications where the torque required by the load is about the same regardless of the speed. Such applications as reciprocating compressors and positive pressure blowers fall in this category. These motors can be of either design *B* or design *C* construction. Variable torque motors develop starting and breakdown torques that are proportional to the speed. The horsepower developed at the various speeds varies as the square of the speed. These motors can be used to drive fans, blowers, and other devices in which the horsepower required decreases as rapidly as the square of the speed.

Wound Rotor Motors

Wound rotor motors are generally used where adjustable speed is required, and only alternating current is available, or where particularly high starting torques and low starting currents are required.

Motors of this type have stator windings similar to those used in squirrel cage motors. The rotor, however, is provided with an insulated winding with leads connected to collector rings. Carbon brushes ride on these rings, and they can be connected to an external resistance. Drum controllers or contactors are used to cut this resistance out of the circuit with each successive step of the control.

When speed adjustment is required, controllers can be used to obtain varying adjustable speed over approximately a two-to-one range. Speed reductions of more than 50% give unstable operation, and are not recommended in the average application. It should be remembered that at any point of adjustment the speed will vary with any change in the load. By proper setting of the controller the initial starting current can be reduced to full load values. Typical speed-torque curves are shown in Fig. 7, for full voltage and re-

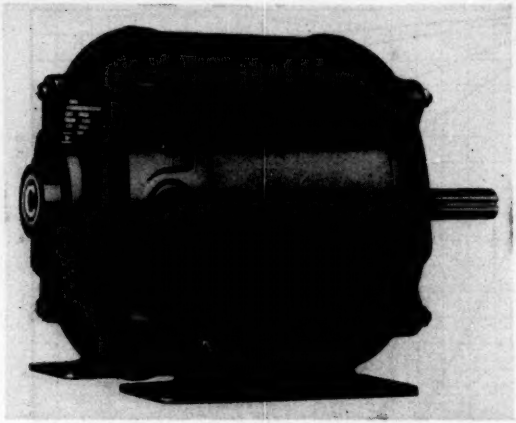


Fig. 8. Fractional horsepower split phase motor (single phase).

duced voltages obtained by inserting different values of secondary resistance.

When wound rotor motors are used to obtain adjustable speed operation, the proper controller resistors must be selected. The type of resistor used depends on the application, since constant torque loads require different resistors than do variable torque loads.

Service Factor

General purpose polyphase motors of the open type carry a service factor of 1.15, which means they will carry a 15% overload continuously without reaching dangerous temperatures. Both the voltage and frequency must be held at nameplate values when motors are operated at service factor loads.

Service factor usually applies only to open general purpose single speed motors. Such factors are not carried by the following type motors: Splash proof, totally enclosed, totally enclosed fan cooled, motors that carry special temperature and time ratings, and multi-speed motors.

Motor Enclosures

Enclosed or partially enclosed motors are practically identical with open motors in operating characteristics. Many different types of enclosures are available, each designed to suit particular application requirements. The most common types are: Open, drip proof, splash proof, totally enclosed, and explosion proof. Totally enclosed and explosion proof motors can be either non-ventilated or fan cooled, depending on the motor size and the application.

Insulation

Virtually all of the motors used on heating and ventilating equipment are constructed with class *A* insulation. This insulation involves the use of cotton and resinous coated wires with various types of paper, linen or cotton materials for slot insulation and phase insulation. The entire winding is usually covered or impregnated with an insulating varnish. Insulation of this class is good for a maximum hot spot temperature of 105C (221F). For more severe service, class *B* insulation is available. This class of insulation includes glass, asbestos, and mica, and is good for a hot spot temperature of 125C (257F).

For some applications, class *H* insulation has been used. These special application motors are usually designed for a very high output for short periods of time. This class of insulation makes use of glass and ceramics, and is not generally available for standard motors. No definite temperature limits have been set for this class of insulation.

High temperatures have a definite effect on organic insulation. It is generally accepted that the life of organic insulation is cut in half for each 10C rise in temperature. A motor with a 40C or 104F rise operating in an ambient of 40C might last 20 years. By changing the rise to 50C or 122F the life expectancy of the insulation becomes 10 years; raise it to 60C or 140F and the life expectancy does down to 5 years.

Operating Temperatures

Many people attempt to measure motor temperatures by laying their hand on the motor. Sometimes a motor feels uncomfortably warm when touched, and this causes unnecessary worry and service calls. It has been reported that any object having a temperature of more than 150F is considered too hot for comfort, and would result in an uncomfortable feeling when touched.

Allowable temperature rise for general purpose open motors is 40C above a 40C ambient. This gives a total rise of 80C or 176F. When motors are operated at service factor loads, this total rise is increased approximately 10C bringing the final temperature to 90C or about 195F. The total temperatures are even higher for enclosed or partially enclosed motors where the permissible rise is 50C or 55C (131F). From this, it is easy to see that fully loaded motors reach temperatures well above 150F, and would feel hot when touched, although they are operating in a perfectly normal manner.

When the temperature of a motor seems to be unusually high, a thermometer should be used to obtain the actual temperature rise. This can be done by placing a mercury thermometer on the motor frame, and covering the bulb with putty or felt.

In this article we have discussed the most popular types of induction motors employed in the heating and ventilating industry. For that reason direct current, shaded pole, and hermetic motors have not been included. It is not possible to include detailed technical phases of motor designs or construction in an article of this length. Instead, the objective was to provide an introduction to the great fund of information available about motor types and their applications. Additional details are available from any motor manufacturer. The design of no piece of heating or ventilating equipment is complete without most careful consideration of the motor to be associated with it. The performance and acceptance of the equipment in the field may depend on the motor. Choose your motor wisely!

Experience is my Classroom

By T. W. REYNOLDS

EDITOR'S NOTE. Mr. Reynolds continues the subject of servicing, trouble jobs, maintenance and similar problems.

Valves

When a heating system does not function as it should, or rather does not heat at all, it should be obvious that no system could be that bad. Look then for the simple and unexpected things. A workman may have closed the main valve while working on the piping and then forgotten to open the valve at the end of the working day in his hurry to get away. A hot water relief valve continually relieves and you find the reason is just a closed valve in the line from boiler to expansion tank. Obviously, this valve should be removed.

Again, it is a closed valve in the pipe between an air compressor and its air receiver. On a steam line with a globe valve installed upside down for complete drainage, should there be trouble, check to see if the valve disc has fallen down and is being held to the seat by the pressure of the steam. Look for the closed valve, or a valve blocked partially open by a piece of wood, and many a problem will be quickly solved.

A motor-operated valve has its own troubles. It is often reversed by the electrician on the job. When the manufacturer's tags on the leads of the motor are correct, the electrician may pay no attention to them; but let the manufacturer slip and tag them wrong, as sometimes does occur, and the electrician will then probably pay attention to the tags and go wrong also.

A 10-inch iron gate valve lies exposed without protectors and a cement truck dumps its load, making a reinforced concrete valve out of it. So the engineer specifies protectors for all valves. This puts the manufacturer between the devil and the deep sea, for the contractor hates these protectors. It means a couple of extra operations for him to remove these protectors of tin, wadded paper, or belted wooden flanges. He does have to make a living and consider costs.

Weighing costs of operating maintenance against costs of preventive maintenance is sometimes interesting. On one job the valves were numerous and of the packing type, therefore requiring operating maintenance. It was then proposed that the valve manufacturer add a protective cover on each valve to catch any leakage and thus confine it. This would eliminate the cost of operating maintenance, but the idea was soon abandoned when it was found that preventive maintenance (for such it was) by the manufacturer at $1.10 per cover was even more costly.

Piping

On new construction it may be that some open end of piping has been used as an overnight hiding place for gloves or overalls stuffed far in. One workman did this, then went to the hospital that night and never returned, the piping being continued the next day. So follow along a hot pipe looking for the place where it abruptly goes cold and therein is the stoppage. It may be debris from new construction, or even a gasket that has never been cut. Pipes stood up-end against a wall are supposedly in a good elevated location for protection of their open ends, but the bricklayers on that wall scatter mortar to the end that the pipes are "mortarfied" inside.

Hot water piping gets air bound because the grade of a main has been run contrary to the arrows shown on the drawing. Does the arrow along the pipe mean grade up or down in the direction it points? The installer may not know because he is seldom given the specifications, but should he have them, usually has no time or inclination to study them and perhaps no understanding of such literature. The drawing is the working instrument in the field and should be so considered, leaving the specifications for the kind and quality of equipment. The installer may grade in the direction of the arrow, but down instead of up, and then carefully install the air vent, per drawing, at the end of the grade. This will leave the pipe air bound at its high point far away from the now useless air vent.

Complaints are often of the most unreasonable nature. It should be obvious to those on the job that 16 inches of water on a roof because of a hard rain is due to clogging of the roof drains. Why should an engineer be called upon to make an air flight to the job when such a situation comes about? In one such case, shavings from new construction had been washed to the roof drain inlets, thus building up water to an unforeseen dangerous roof load. This roof load would have been even greater had not the elevator shaft finally served as an overflow outlet. Calculations for roof loads are usually 40 lb per sq ft, but in the case cited the load was up to 83 lb.

Pumps

When a new vacuum pump is installed with larger motor than that of the replaced pump, it sometimes happens that the owner calls up and says the pump is no good, it is not running. This, you find, is due to overloading of the old wiring, so that some fuse remote from the boiler room has blown. This happens quite often with all kinds of motor-driven equipment.

Again it may be that in wiring up contacts on the starter, the electrician has loosened the holding screws

in the starter casing. Sometimes the complaint is reversed, the pump never stops running. In this event, fuses may be rusted so as to fuse together, or the thermostat may be found controlling around 80F when only 70F is desired.

One heating pump was regulated so that it cut out too frequently. An excess of fuel oil consumption was accordingly claimed until it was pointed out that the excess oil was used before the pump had been put into operation. A centrifugal pump may not be delivering, yet the cause is simple enough if the pump has been so wired that its rotation has been reversed. Pumps have other troubles. Their motors may be single phase and provided with a mechanical or short-circuiting mechanism, or brush release, which needs oiling, but not too much. Motor bearings may be over-lubricated, thus pushing out grease to cause trouble. Things are often under- or over-oiled or greased.

(The question of servicing will be continued in this department in a subsequent issue.)

• FILLING AND CLEANING THE SYSTEM.

It is generally thought that a hot water heating system does not need cleaning out; however, on new construction there is a lot of core sand and grease which returns to the boiler and plays hob with the circulator. Draw down some of this water and it comes out like molasses. Such a mixture cannot heat the building efficiently, nor the domestic hot water supply passing through the heat exchanger.

Few know how (or won't take the time) to properly fill and vent a hot water heating system, especially when it is of the floor panel or baseboard type. Fill must be slow, almost a bleeding process. Many will have water in the second floor radiators before they have fully vented radiators below.

• LIMITATIONS OF SWING JOINTS

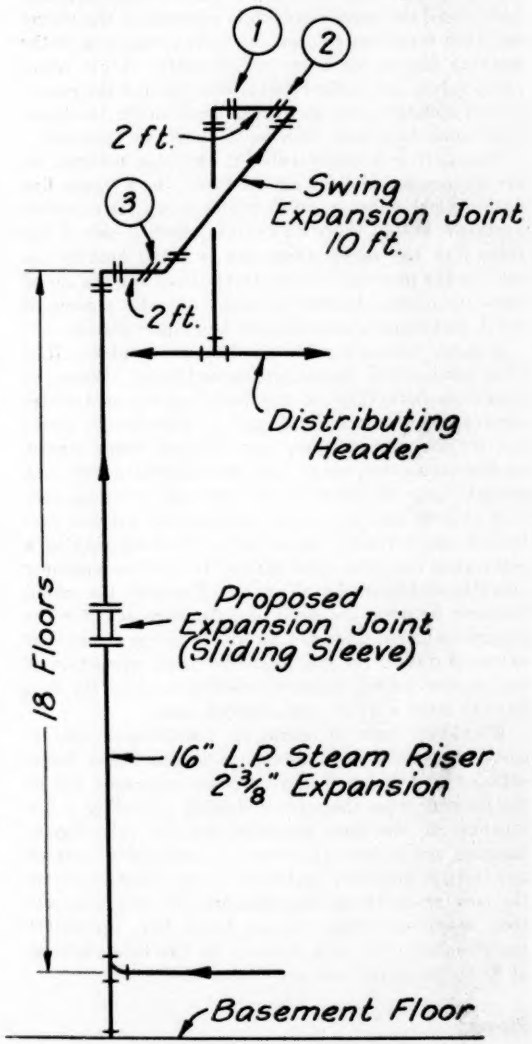
The limitations of swing joints to absorb expansion are not generally realized. Such joints made up with pipe and ells do work when made of small size pipe, because the pipe springs before the fittings turn; however, when the pipe is of large size, as in the accompanying sketch, leaks will result.

The sketch is of an actual installation which has caused trouble for years and is aggravated by frequent expansion due to the intermittent flow of steam under time control in a poorly insulated riser. The expansion for 18 floors is over 2 inches and is evident by scratches where the riser contacts the structure. The swing joint, being of 16 inch pipe, cannot spring, so that it must turn on the threads of flanges at points *2* and *3*, or *1* and *3*. Leakage at threads is usually at *1* and *3*, however; leakage takes place first at the gaskets between flanges because the clearance of bolts in bolt holes allows sufficient movement to destroy the gaskets between flanges and even score the face of the flanges. To make matters worse, leakage at the gaskets rusts the threads and makes the joints rust tight.

The condition can be remedied by installing a sliding sleeve expansion joint midway up the riser, although this is not easy to do because of the large size pipe in a crowded shaft. The pipe where the joint would be inserted must be cut away by torch and flanges then welded on.

When the riser was installed it would have been a fairly simple matter to have installed the joint, but where several trades install pipes in the same shaft, the last pipe installed usually blocks any service on the others. Architects, as a rule, limit the area of pipe shafts, being more concerned with what can be got in rather than what can be serviced at some later date.

Had the riser been of small size, it would be simple to install a flexible ball joint at the top of the riser to take the expansion. Such joints are obtainable up to 4 inches pipe size. Someday someone will invent a ball-type expansion joint in larger sizes which can be easily installed at the top of a riser where head room is too limited for any other type of patented joint.



Swing expansion joint that caused trouble.

Some Heat Pump Design Problems

T. C. JOHNSON
Air Conditioning Dept.
General Electric Co., Bloomfield, N. J.

Before the heat pump as a business enterprise can be moved out of the custom built class into the reach of the general consumer, several technical, economic, and practical problems must be solved. Mr. Johnson has discussed[1] some of the basic design problems of the heat pump and indicated areas where first steps toward standardization might prove effective. Such problems as the proper heat source, house design, reliability, and serviceability are discussed but no estimate is made of the detailed merits of various heat sources. For convenience and emphasis of certain problems, an air to air system is assumed.

ONE of the principal obstacles to commercial development of the heat pump is the inherent nature of the motor compressor in the refrigeration circuit. In heat pump installations, where both the requirement and the availability of heat are extremely variable, the design point of the motor loading on the compressor is extremely difficult to determine.

In an air-to-air heat pump, the ability of the unit to supply heat increases rapidly as outdoor temperatures increase; whereas the need of the house for heat drops with rising outdoor temperature. This relationship is shown in Fig. 1. At the rating point, the heat supplied by the heat pump exactly balances the need of the house for heat at the design weather conditions.

The specific volume and absolute pressure for a range of temperatures possible in the evaporator (outdoor coil for the heating cycle) are shown in Fig. 2. At an evaporator temperature of —10F (corresponding approximately to outdoor temperature of +5F) the specific volume of gas is 2 cu ft per lb; whereas at 40F evaporator temperature (outdoor temperature 55F) the specific volume is .79 cu ft per lb. This is a ratio of 2.5 to 1, and if the compressor runs at a constant speed, the total heat capacity of the unit is increased 2.5 times while the requirement for heat has gone down almost to 1/6 of the value at 5F outdoor temperature.

This same condition is found regardless of the evaporating refrigerant used, and therefore poses a fundamental problem of the heat pump designer.

The obvious solution would be to run the compressor more slowly for low heat demands (and high heat availability). The ability of an efficient compressor to pump refrigerant varies directly with its speed and the specific density of the incoming gas, while the density of the gas is a function of temperature. However, under the combined dictates of efficiency, cost and simplicity, the a-c induction motor has been the almost universal choice for driving a compressor, even though its constant speed results in the heat supplied —heat needed discrepancy of Fig. 1.

A second disadvantage of the constant speed motor compressor is that in milder weather heat is supplied in extremely short cycles which are undesirable for comfort reasons and have a deteriorating effect on motors and controls.

A number of solutions are possible for this major design problem, though none of them is as complete or efficient or inexpensive as desirable. The choices are: (1) varying the number of cylinders in operation for a multi-cylinder compressor; (2) varying the number of compressors in service for a multi-compressor unit; (3) varying speed of the compressor; and (4) artificially controlling the amount of gas that can be pumped by a given compressor. The latter choice, while it can be accomplished simply, results in very inefficient operation and is usually not considered.

For every 15 degrees increase in operating temperature, the required pumping capacity of the compressors is reduced by about one-half. For, example, in Fig. 1, an eight-cylinder compressor operating full capacity to 15F outdoor

[1]Based on his paper delivered at the AIEE conference on electric house heating and the heat pump, February 3, 1950, New York, N. Y.

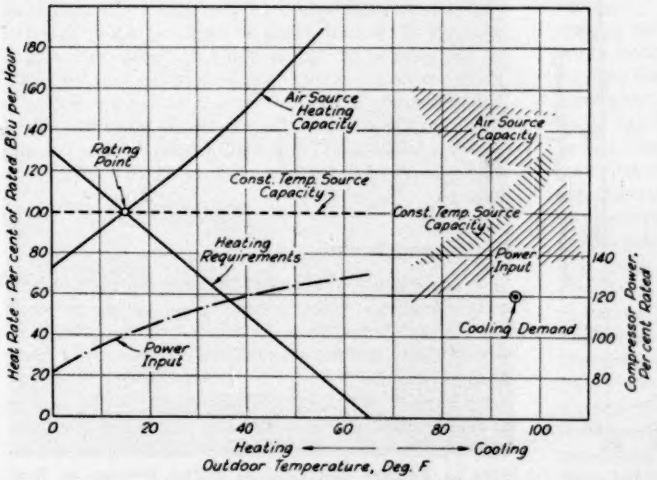


Fig. 1. Performance characteristics of air-to-air heat pump.

temperature would need only four cylinders in operation at 30F outdoors and only two at 45F. The problem of disconnecting individual cylinders, and losses in efficiency when using a fraction of the total number of cylinders, are part of the difficulty of this solution. Increasing the number of compressors gives greater economy but with only partial flexibility and may result in an increase in over-all complexity.

Heat Source

A constant temperature heat source for the heating cycle reduces the severity of this problem but of course introduces the additional problem of the availability of such a heat source. The availability of heat source, such as sufficient water, has been a more serious problem than the balance of compressor power. In all probability no one design can ever be the right one for all applications. In air-to-air applications, the solution most likely under present conditions will be either use of several compressors or variation of the number of operating cylinders, or both.

The heat pump tends to work at greater efficiency and pumps more Btu per kwh when the temperature difference from high side to low side is decreased. Thus, in relatively mild weather the coefficient of performance is very attractive. However, heating and cooling installations must be designed to cope with expected extremes in weather, and a compromise must be made so that the over-all performance is as high as possible.

For comfort reasons, it is essential to size the heat pump properly for a given application. As shown in Fig. 1, any discrepancy between heat supplied and heat needed increases rapidly as the outside temperature decreases. Present information is inadequate to size

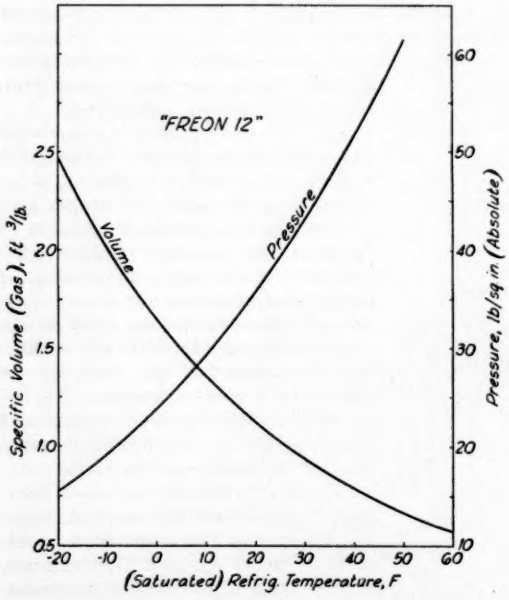


Fig. 2. Specific volume and pressure of Freon-12.

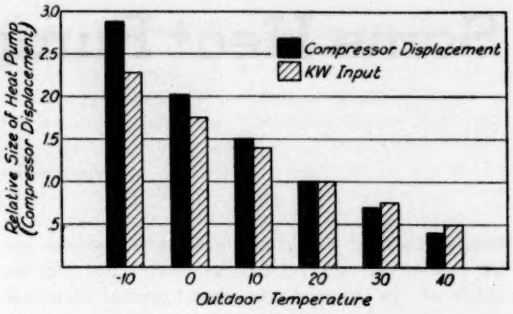


Fig. 3. Effect of choice of design temperature on size of heat pump, using air heat source.

heat pumps accurately for small power installations required in a home. Heating and cooling needs can be estimated only roughly and the ratio of the two, which is equally important since it determines the arrangement of the equipment, is even more in doubt.

As the design temperature for the proposed installation is lowered, the size and cost of the equipment rapidly becomes larger. Fig. 3 shows the relative size of heat pumps in terms of compressor displacement when designed for various outdoor temperatures. For 0F outdoor design temperature, the compressor displacement is twice as large as it is for a 20F design temperature. The effect of too wide a margin for safety on first cost of the equipment is obvious.

Close attention to records of the Weather Bureau for a representative city throughout a typical heating season shows that the lowest temperatures recorded are quite low and occur at rather long intervals. This fact may have great importance for heat pump designers if the thermal flywheel effect can be utilized to allow a relatively small size unit to carry over the low temperature peaks of heat demand. Thus it is uneconomical to size heat pumps by rules now used on conventional systems. In the first place, the required size of the heat pump equipment would make the first cost almost prohibitive. In the second place, the full capacity of the unit would be used only a tiny fraction of the year, if at all. A study of requirements in a given season has shown that 98% of the heating (total Btu delivered) can be done with a heat pump only two-thirds as big as it takes to handle the other 2% of the season's heat. That is, one-third must be added to the heat pump to handle the lowest 10 degrees in a given climate.

Motors and Controls

A fundamental problem of motor application to heat pumps is that of power supply. Single-phase power is all that is presently available in most locations and present lines will not generally allow addition of more than occasional 3 to 5 hp motors without requiring considerable stiffening. While public utilities are watching development of the heat pump and considering whether its growth justifies anything so expensive as 3-phase distribution, initial designs of heat

(Concluded on page 128)

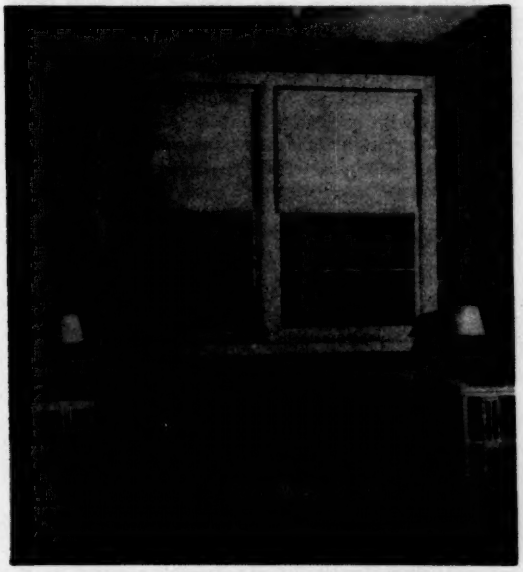
Heating Buildings by Electricity

W. F. FRIEND
Mechanical Engineer, Ebasco Services, Inc.
New York, N. Y.

House heating by electric resistance methods, while attractive to many because of its convenience and newness, must compete with heating systems served by relatively low-cost fuels. This 2-part article is a condensation of a paper, Electric House Heating, presented before the Midwest Power Conference in Chicago. Part 1, May issue, was on the required capacity of heating installations, and load characteristics. This section, Part 2, describes the principal types of electric heating systems.

THE principles employed in electric house heating for heat transfer and distribution, temperature control, and cyclic operation, and the variety of apparatus that has found application, outnumber those for systems utilizing fuel. This can be ascribed to the inherent adaptability of electric energy for transmission, conversion and regulation, and more importantly to the relatively high unit cost in terms of thermal equivalent as compared with fuels traditionally used for house heating—which necessitates and justifies greater attention to efficient utilization.

In Table 3 are classified the principal systems currently in use. Remarks concerning unique characteristics or special features of certain systems follow the tabulation.



Installation of 1,000-watt recessed Glassheat panels installed in a home in New Canaan, Conn.

TABLE 3—PRINCIPAL TYPES OF ELECTRIC HOUSE HEATING SYSTEMS.

Central Warm Air
- Resistance-element bank in housing or air duct
- Fuel-fired furnace converted to electricity

Central Hot Water
- Water pumped to radiators or convectors in rooms
- Same with off-peak storage (Hall System)

Radiant Panel Installation

Ceiling Panels
- Electrically conductive rubber (Uskon, Goodrich)
- Plastic sandwich with embedded conductors

Wall Panels
- Wallpaper type with embedded conductors
- Rigid panel, as for ceilings

Floor Panels
- Electric conductors embedded in concrete slab
- Soil-heating cable under ceramic or in slab tile

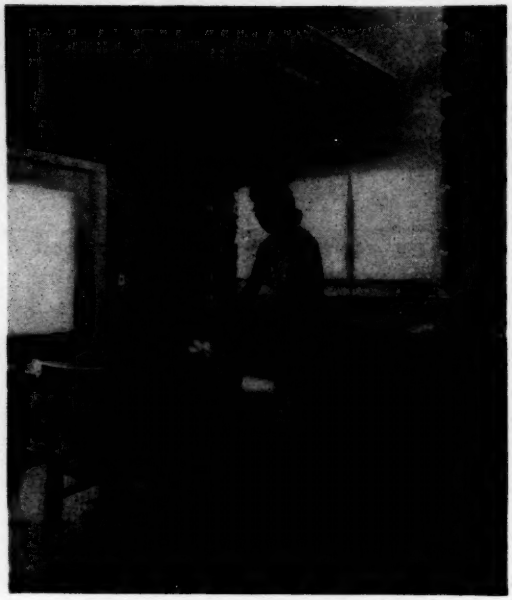
Radiant-Convection Units
- Glass unit (Continental, Appleman)
- Resistor unit, with exposed or embedded conductor
- Baseboard-type resistor

Portable and Unit Heaters
- Resistor, high or low temperature
- Resistor with fan
- Radiant bowl with parabolic reflector
- Steam radiator with immersion electric element

Heat-Pump Systems
- Warm-air distribution through ducts
- Radiant wall panels, with condenser tubing embedded in plaster

A primitive form of electric heating was the conversion of existing warm-air heating systems, by inserting resistors in main distribution ducts or indirectly within the combustion chamber of a coal- or oil-fired furnace. In many cases the resulting electric costs proved excessive, because the houses lacked adequate insulation; heat losses from furnace and duct system were high, and householders accustomed to low-cost fuel were reluctant to adopt devices and expedients for avoiding waste of heat. Successful conversion of old warm-air system is difficult and has seldom been accomplished.

A more practicable form of central heating with electricity is hot water circulation to conventional radiators, to convectors concealed in walls, or to baseboard type radiators, from a water heating tank. With thermostatic control of water temperature leaving the immersion-element heater and of the motor-driven circulating pump, fluctuations of outdoor temperature are readily compensated and wasteful overheating is prevented. Time lag in the response to demand for heat, however, is little better than with ordinary fuel-fired hot water systems. Here again, conversion of



Uskon panels installed in this dining room ceiling to supply radiant heat.

existing installations is rarely advisable unless the house can be thoroughly insulated and the owner educated in economical heat-utilization practices.

The benefits obtainable with thermal storage, especially where enough storage can be provided to enable controlled off-peak operation of the electric heating elements, has received much attention through the years, particularly with hot water heating systems. The so-called Hall system, under General Electric sponsorship, was soundly designed and carefully applied for field trial in certain regions having around 5,000 degree-day climate, and where proportional off-peak rates were offered by the local utility company. Few if any of these installations survive. Factors contributing to mortality of the Hall system were: high installation cost, space for insulated 250F water tank as large as 5 ft diameter by 12 to 15 ft long for 6- to 8-room house, connected load 20 to 35 kw for immersion elements and circulating pump, and the ultimate withdrawal of the low off-peak rates—substantially under one cent per kilowatt-hour, to compete with coal and oil at prices then current.

Application of the off-peak principle with heat storage in solids, including metals, concrete, natural rock, and earth has likewise been the object of much experimentation for warm air systems—without results of commercial value. At the present time, certain salts that have melting temperatures between 90 and 120F, such as sulfates and phosphates of sodium and calcium, are under investigation for solar house heating systems and as supplementary heat source for electric heat-pump installations. If the experiments prove successful, the method can be applied also to resistance-type house heating.

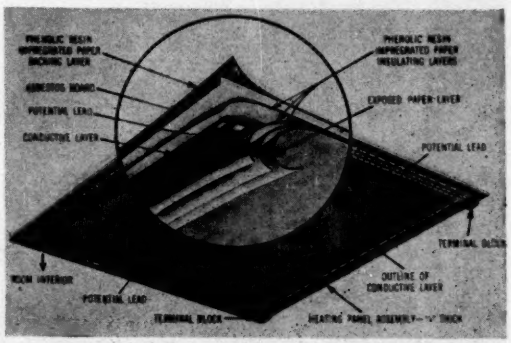
The radiant panel system, using factory-made rigid panels containing a layer of electrically conducting rubber or of plastic composition surrounding embedded filaments, has been used successfully on ceilings. Panel ratings are generally 12, 17 and 22 watts per sq ft, giving surface temperatures 95 to 120F. Extent of ceiling area utilized is about 60% maximum, to provide convection currents and thereby to avoid stagnant air effect. Stratification with excessive vertical temperature gradient and the pocketing of heated air in upper part of room, originally feared with ceiling-panel heating, are rarely encountered. When properly designed and installed with suitable automatic control, this method has shown quite satisfactory performance, but initial cost is relatively high.

Wall panels like those for ceilings are applied alone or in combination with ceiling and floor panels, under special conditions. There are also flexible sheets, resembling heavy embossed wallpaper, that contain filament conductors. Surface temperatures are limited to 130F and thermal insulation on the cold side is essential for good performance and for economy.

Floor type installations are the predominating form of true radiant panel heating. They usually employ conductors insulated with synthetics, arranged in series-multiple circuits for temperature control, which are embedded in a finished layer of 2½-inch concrete or cement. Permissible surface temperature is 85F maximum for comfort, but some individuals dislike floor temperatures over 80F. For bathrooms, entrance foyers and other short occupancy space, ceramic tile floors may be laid over lead-sheath soil-heating cable; permissible surface temperature is as high as 95F in such locations. With any form of floor-panel heating, the kind and extent of floor covering is restricted, once the design has been decided upon.

Radiant Convection Units

Radiant convection units recessed into walls below sill height, and usually in exterior walls beneath windows, are an early form of electric heating recently revived with certain improvements. Surface temperatures from 150F up to incandescence above 1,200F are used, with protective guards, rear insulation and definite provision for convection-air movement. In bathrooms and occasionally in long-occupancy rooms



Construction details of the Uskon panels used as a part of an electrically operated radiant heating system.

such units are in interior walls to simplify wiring. A relatively new variety uses electrically conductive glass or a metallic film bonded to rear of heat-resistant glass; these units are commonly rated 600 and 1,000 watts, and are loosely described as radiant panels. Test data indicate 35 to 40% of total heat transfer is by convection; moreover, radiant effect from surfaces at temperatures above 250F gives directional heating and skin reaction noticeable to sensitive persons.

Table 3, which lists the several types of portable unit heaters and the heat pump systems, brings to attention the variety of methods by which electric energy is being applied for house heating. In general, the recent trend has been toward decentralized systems employing a number of independent small units, each under separate thermostatic and manual control, enabling and encouraging economy in electric consumption by curtailment of heat in unoccupied rooms. This is a distinct reversal from the development, a generation or two ago, of so-called central heating which enabled maintaining uniform temperature at all times in all the rooms throughout the entire house.

TABLE 4—ELECTRIC SERVICE FOR UNIT HOUSE HEATING—COST COMPARISON WITH FUELS COMMONLY USED

Energy Form	Type of Heating System	Unit	Heat Content of Unit, Btu	Effcy, %	Price	Btu per 1¢
Elec	Resistance devices	Kwh	3,413	100	$ 0.02	1,700
	Heat pump			300*		5,100
Oil	Air, steam, water	Gal	141,000	70	0.14	7,000
Gas	Air, steam, water	Mcf	1,000,000	75	0.50	15,000
					1.00	7,500
Coal	Air, steam, water	Ton	24,000,000	55	10.00	13,200
					20.00	6,600

*Efficiency indicated as 300% for heat pump systems corresponds to seasonal performance factor 3.0, which is higher than presently obtained in the Midwest.

Comparative Heat Costs

To indicate roughly how heat from electricity compares with that from fuels, Table 4 gives data representative of current price levels. Efficiencies shown are on seasonal and heat-delivered-to-system basis.

Costs in the last column, expressed as Btu per one cent, cannot be used directly for calculating seasonal electric or fuel cost, because substantial adjustments are necessary for type and quality of house construction, for mean indoor temperature actually maintained, for quantity of ventilation air provided, and for other circumstances that vary as between houses having the respective types of heating plant.

Conclusion

The information now available on electric house heating load characteristics and performance is insufficient for determining whether a broad market for this service is at hand, or whether applications will continue to be limited as to location and conditions of use. Data from many more test meter installations must be assembled and analyzed, with reference to the critical elements of load factor, coincidence factor and peak responsibility. Also required are studies of incremental investment in utility-system facilities as related to house-heating load saturation and customers' other uses of electricity.

New Code Issued for Pressure Piping

New and important safety requirements for the various piping systems throughout the nation that carry liquids or gases at high pressure are contained in the 1951 edition of the American Standard Code for Pressure Piping that has just been published. The new edition of the code was prepared by a widely representative committee, sponsored by the American Society of Mechanical Engineers under American Standards Association procedures. It establishes minimum safety requirements for various piping systems ranging from tiny systems operating delicate instruments to the huge pipe lines carrying gas and oil for thousands of miles across the country. The original code was published in 1935 and also was adopted as an American Standard.

In 1942 when the edition preceding the 1951 edition of the Code for Pressure Piping was published, the largest heavy-duty cross-country gas pipe lines were 20 to 24 inches in diameter. Since that time the Federal Power Commission has issued certificates for nearly 34,000 miles of new long distance lines extending from southwestern producing fields to eastern consuming areas. Several of the recently installed heavy-duty lines were 30 inches in diameter, and a 34-inch line is now under construction.

Steady improvement in materials has made it possible to increase pipe diameters for a given wall thickness without a corresponding decrease in gas pressures. Not only is the greatly enlarged volume of gas transported a significant item, but it is estimated that the now more efficient use of steel makes it possible to save as much as 100,000 tons of steel on one cross-country pipe line alone.

Development of new specifications for materials has been recognized by eliminating some of those formerly in effect and substituting new American Society for Testing Materials and American Petroleum Institute specifications now in general use. New requirements have been included for pipe (except cast iron pipe) in gas and air compressing station piping systems. These will result in thicker pipe walls, other factors being equal, than previously required.

Scrapbook of Exhaust Hood Design

Part 12—Control of Dust from Woodworking Machinery

JOHN M. KANE

Chief Engineer, Dust Control Division, American Air Filter Co., Louisville, Ky.

THE woodworking industry was one of the first to recognize the need for local exhaust ventilation and to apply it universally to their operations as a means for improving their working conditions and housekeeping. Increased cutting speeds of modern woodworking machinery have increased the amount of work processed and, correspondingly, the volume of dust, shavings and/or chips produced. The latter, in turn, has required the modification of hood details in many cases, and frequently an increase in exhaust volume to provide acceptable control.

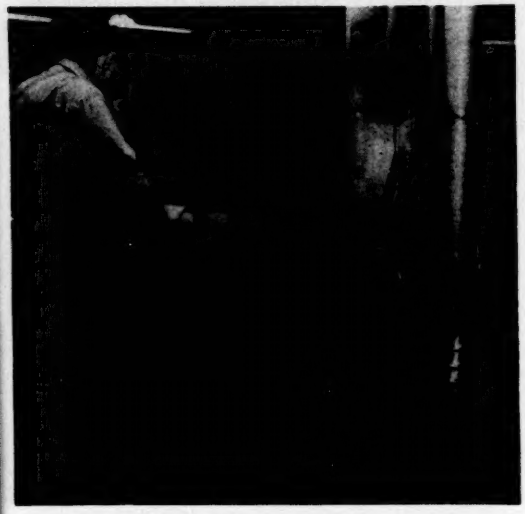


Fig. 1. Typical exhaust hood for head pulley of horizontal top run belt sander.

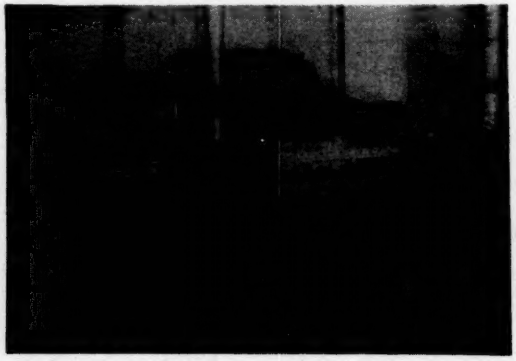


Fig. 2. Good hood design will enclose as much of the sander belt as possible.

Sanders—These machines create the finest dust particles released in any woodworking operation, and effective hooding is essential to prevent the dispersion of fine sander dust throughout the workroom. The horizontal top run belt sander requires exhaust hooding at the head end and frequently a companion hood for the opposite pulley. The hood of Fig. 1 has been designed to concentrate the exhaust volume at the top of the belt toward which sander dust is thrown by the direction of belt travel; and at the bottom of the belt to give a scouring action to prevent carryover of dust due to the air currents set up by the high belt speed.

While shielding of the open area between top and bottom run will produce this effect, the more positive distribution of separate exhaust connections has considerable merit. It also illustrates the design theory of extending the hood to enclose as much of the top and bottom run of the belt as is practical for the size of work finished. One of the disadvantages of so-called standard hoods for a given machine tool is that the hood must be designed to permit operation throughout the entire range of its usefulness. In many cases, such as Fig. 2, such standard hoods can be modified to meet the specific range of its particular operation and thereby provide more complete enclosure and enable the hood mouth to be located closer to the point of dust generation.

This principle of adjusting hood design thinking to the limitations of the actual work processed is illustrated in Fig. 3. Hood construction must be such that sander belts can be readily replaced. Hinged hood sections, Fig. 4, illustrate excellent recognition of this requirement on the part of the hood fabricator.

Fig. 3. Effective hooding of this edge sander is obtained by enclosure of the head pulley and the addition of local hood at tail pulley.

Fig. 4. Note location of hood mouth and the hinged section features of this edge sander hood that permits ready access for belt changing.

Hooding for the drum sander consists of a curved cover plate over the drum and a fishtail exhaust slot the length of each drum. With multiple drum sanders, present practice on high speed units is to add one extra fishtail hood and exhaust duct on the downstream side of the final drum. On some designs, an additional suction connection is employed to clean the feeder belts as they leave the guide pulley on the bottom of the discharge end.

Saws—While hooding of the conventional circular table saw and swing saw is commonplace, some special sawing tools require variation to standard saw hood design thinking. The overhead type, self-feed rip saw, Fig. 5, has an exhaust connection attached to the side of the saw and an additional exhaust above the table. Where the saw travels horizontally, dust is produced

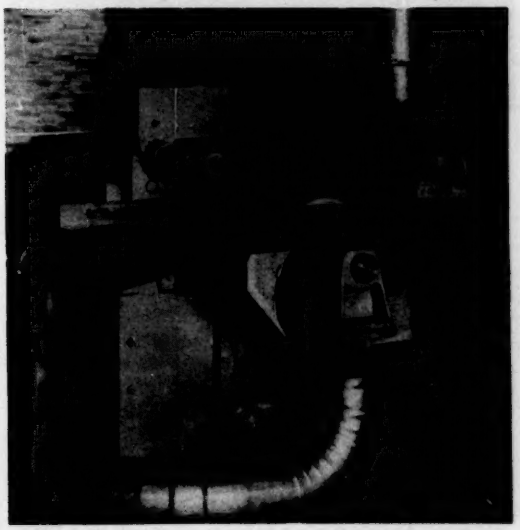


Fig. 5. Exhaust hood details for a self-feed rip saw.

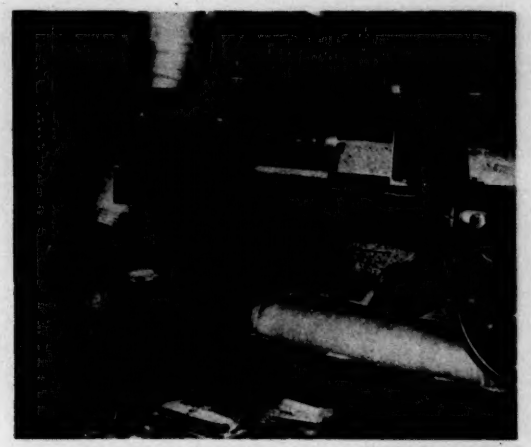


Fig. 6. Cleanout provisions have been incorporated in hoods and dust elbow for the traveling saw-table rip saw used for veneer cutting.

Fig. 7. Local hood construction for a production type wood borer. Note the hood extension for surrounding the auger.

throughout the length of its cut and the hooding, Fig. 6, must provide a downward flow of air throughout the width of the machine. Cleanout doors in hoods and in elbow at end of horizontal main are essential for clearing of long slivers that can be carried to the hooding and duct work but whose length prevents transport through the exhaust system to the dust collector.

Wood Borer—Even the boring of holes on a production basis creates volumes of chips that recommend exhaust hooding, Fig. 7, and local exhaust ventilation to convey the chips to a central disposal point. While hood extension surrounding the auger may restrict observation, such an addition to the side hood will greatly increase exhaust effectiveness where practical to install.

Moulder—Increased capacity of moulders, with the introduction of high frequency motors to increase cutter speeds, has jumped the quantity of material that is removed and which must be picked up by the exhaust system. Logically, exhaust connections and hoods are required for the four heads as indicated in Fig. 8. Hoods for the right and left matcher heads must be

Fig. 8. Exhaust connections are required for each of the four cutters on the high speed moulder.

Fig. 9. Flexible duct connections are indicated for double-end tenoner. Note hood detail in foreground for cut-off saw dust control.

Fig. 10. Hood construction for upper tenon and exhaust branch duct to lower tenon hood can be noted for this double-end tenoner.

Fig. 11. Duct connections for the single-end tenoner is simplified by the absence of horizontal movement of the saws.

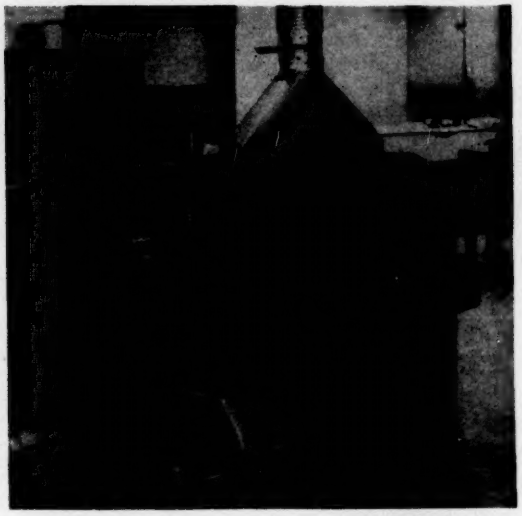


Fig. 12. Single planers require an exhaust hood above the cutter. On the double surfacer, a second hood is installed below the lower cutter.

adjustable to follow cutter location, which explains the telescope joint in the vertical branch and the two ball and socket joints. Usually the manufacturer provides the exhaust hood for the top head and the hood for the bottom head is incorporated within the moulder base. Cleanout provisions in the elbow of the branch connection to the bottom head hood outlet are recommended. Where a profiler head is included with the moulder, additional hood and exhaust branch equipped with telescope joint are required.

Tenoner—Exhaust hood and duct connections will be required for each saw, top and bottom tenon, and for cope and/or dado cutters when employed. The extensive adjustments incorporated in the double-end tenoner necessitate flexible branch connections to each movable exhaust hood, as indicated in Fig. 9, which also provides an excellent illustration of the hood design suitable for control of the saws. Fig. 10 illustrates the hooding for the top tenon and the exhaust branch connection for the bottom tenon hood. Duct connections for the single-end tenoner are simplified, as indicated in Fig. 11, by the elimination of the need for hood movement in a horizontal direction.

Planer—Exhaust volumes for planers will be a function of the cutter width with an exhaust hood above

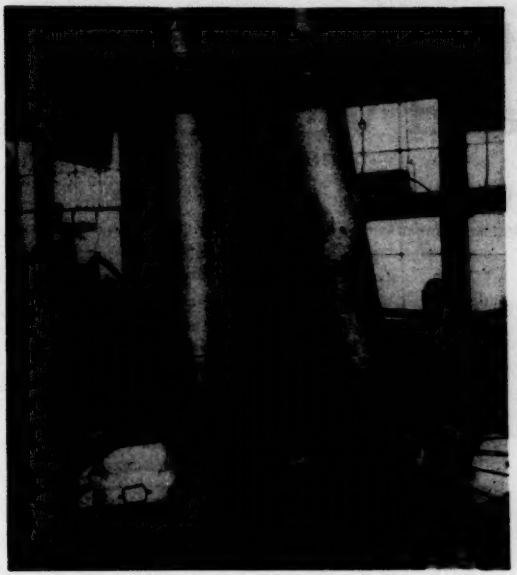


Fig. 13. Hoods for automatic shaper cutter heads must be provided with a telescope joint and ball and socket joints to allow hood to follow cutter movement.

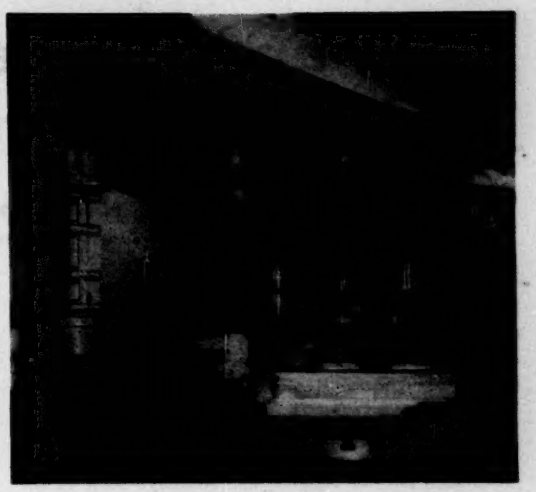


Fig. 14. Hood construction for the automatic shaper is further complicated by the clearance required for the moving arms supporting the cutter heads.

the table in the case of the single surface shown in Fig. 12. Same top hood is required for the double surface planer but an additional hood and exhaust branch will be necessary, enclosing the bottom cutter.

Shaper—Fig. 13 shows duct and hood construction for the automatic shaper heads where hood design and method of support must permit movement to follow the path of the cutter head. Hood design to clear cutter head arm is more clearly indicated in Fig. 14.

Exhaust Volume and Transport Velocity—Exhaust volume will vary with cutting speeds, length of cutter heads, length of sander drums, and diameter of saws. In general, saws require 4- to 6-inch branches; most cutting heads a 5-inch branch. Conveying velocities of 4,000 fpm in branch ducts and 3,500 fpm in mains will be ample if branch ducts are large enough to handle necessary volume at the 4,000 fpm rate. Where exhaust air is used for transport of material, as in the case of hogged refuse or gathering of material from dust collector for transport by air to a central disposal point, conveying velocities of 4,500 to 5,000 fpm are recommended, with exhaust volume of 50 cu ft for each pound of material handled.

Acknowledgment

The exhaust hood photographs and much of the data included in this discussion was made possible through the active cooperation and assistance of Kirk & Blum Mfg. Co., Cincinnati, Ohio, and A. E. Carsey of that company.

Du Pont Expands Its Experimental Station

Nineteen buildings, of which nine are laboratories, comprise a $30-million extension to the Du Pont Experimental Station at Wilmington, Del. Designs were prepared by Voorhees, Walker, Foley and Smith, New York City. They were assisted by 75 specialty contractors in the construction phase of the work.

The buildings are arranged on the campus plan with parking space so that employees can leave cars adjacent to the building where they work. At first, consideration was given to a consolidated laboratory building but this was abandoned in favor of the quadrangle arrangement which permits greater flexibility of operation.

In all, about 630,000 sq ft of floor area are provided and the station has some 158 separate laboratory units. This project, which required 2½ years to complete, was under the direction of the company's engineering department.

As part of this group of buildings is the Lavoisier Library containing 25,000 volumes.

New buildings of Du Pont's Experimental Station at Wilmington, Del., are arranged campus style.

Laws and Regulations Controlling School Heating and Ventilating

NATHAN N. WOLPERT
Associate Editor, Heating and Ventilating

Here is Part 4 of a group of articles covering state laws and regulations drafted to govern the proper design and installation of heating and ventilating system in schools. It closes this series.

Oregon

No such laws or regulations. Although some of the cities have adopted codes which govern locally, the state tries to follow the recommendations of the Guide for Planning School Plants, published by the National Council on Schoolhouse Construction.

Pennsylvania

Information regarding this state is from Sections 116-133 of the regulations of the Department of Public Instruction, published in 1950.

While schoolrooms are occupied, temperature and ventilation shall be maintained as listed in Table 5.

School toilets, shower and locker rooms, and kitchens must be ventilated mechanically by exhaust fans discharging the vented air above the roof line separately from the general ventilation system. Toilets, shower and locker rooms, in order to replace the exhausted air, should have 3 inches cut from the bottom of the main entrance door. If necessary, this can be supplemented by a fixed louver grille in the lower panel. Where such rooms are large or where it is not practical or desirable to replace the air exhausted from them from adjacent parts of the building, means must be provided to supply and temper outside air to replace the air that is exhausted. Toilet vents may be either at the floor or ceiling. Wherever possible, replacement air for kitchens shall be drawn from the serving space.

While the use of automatic temperature control is not enforced, it is recommended.

Fan-duct systems are acceptable; heat may be applied directly to the air by warm air furnaces, or steam radiation. Automatic humidity control is required.

Steam radiation may be used in rooms requiring ventilation to supplement the heat furnished by the warm air, and in other rooms to furnish the total heat required. When it is installed to supplement ventilation, only sufficient steam radiation may be installed to maintain room temperature at 50F in zero weather. In extremely cold localities, the commonly accepted design practice for that locality may be substituted for 0F but the design figure cannot be less than —10F.

Recirculation may be obtained by using the attic or other space as a plenum from which to return air to the fan, or locally within the room itself. Local recirculation, normally furnishing 50% outside air, may be arranged to increase the amount to 100% to aid in temperature regulation. Recirculation obtained by venting rooms into corridors or their equivalent or by using them as conduits for air is not permitted. However, space above dropped ceilings of corridors may be used for ducts.

TABLE 5—TEMPERATURE AND VENTILATION REQUIREMENTS.

Room	Amount of Outside Air Required	Temp., F	Total CFM per Pupil	Air Changes per Hour
Class, study, recitation	50%	70	30	Not rated as changes
Assembly, lecture, library	50%	70	30	But not less than 6 changes
Domestic science, general and chemical laboratories	(1)	70	30	6
Shops (2)	(1)	65		
Auditorium (3)	50%	70		6
Gymnasium (3)	50%	65		6
Play	50%	65		6
Toilets (4)	None	60		6
Shower and locker (4)	None	80		6
Kitchen (4)	None			6
Cafeterias, service space	100%	70		6
Laundries (1)	100%			6
Corridors	100%	65		

(1) Fifty percent outside air is permissible if atmosphere is not contaminated. If smoke, fumes, odors, imflammable dusts, or other atmospheric contamination, or hazard is produced, 100% outside air must be supplied, and venting must be entirely separate from the general venting system. In addition, apparatus and equipment producing smoke, etc., such as experimental tables, fume cabinets, cook stoves, steam tables, forges, welding booths, spray painting stations and the like must be equipped with mechanical exhaust fans or fan system, hoods, canopies, their equivalents and accessories to collect the foul air and vent it separately from all other venting. The mechanical exhaust must have sufficient capacity to prevent smoke, etc., from permeating the surrounding air, and must be operated at all times during use of equipment that does or might produce smoke.

(2) In isolated agricultural and mechanical shops, mechanical exhaust may be omitted when individual hood vents are run to individual roof vents.

(3) In figuring the cubic feet of volume of gymnasiums and auditoriums, 15 ft plus ¼ of the excess over 15 is used as the effective height or measure of the need for ventilation.

(4) This department does not require mechanical exhaust for single toilets, not intended for pupils or public use, but requirements of the Department of Labor and Industry must be met.

States are not arranged in full alphabetical order.

Heating and ventilating unit systems, operated by steam, are permitted with or without supplemental steam radiation. Use of steam radiation in connection with heating and ventilating unit systems is permitted as with fan-duct systems. Such units, normally furnishing 50% outside air, may be arranged to increase this amount to 100% to aid temperature regulation.

Ducts must be of material that is substantially proof against fire, smoke, fume, odor and corrosion. They should have smooth interiors, be gastight, mechanically strong, and properly supported. Ducts for chemical fumes or for anything involving a hazard must be of suitable material. Ducts of lath and plaster are not permitted. Sizes and air velocities must be those generally accepted for similar or parallel applications by recognized engineering practice and the ASHVE. The ducts cannot have abrupt changes in direction, area, or in the relation of length to width.

Maximum permitted velocities range from 300 to 1,200 fpm, according to place and application as follows:

Velocity at air supply intake opening ranges from 300 fpm for intakes at or near grade to 850 fpm for those at or above roof line in positions where there is no possibility of contamination by vented air, smoke or fumes. The judgment of the designer is respected in choosing intermediate velocities.

Velocities at air supply discharge openings, including heating and ventilating units, shall be from 300 to 1,200 fpm, depending on position, angle of delivery, and diffusion. There shall be an absence of noise. Floor registers are not permitted. Special attention must be paid to the temperature of the entering air to keep it within limits of recognized practice, both on the high side in the design of the system for heating and on the low side as may be introduced by temperature regulation. The recirculation duct must be equipped with a fire damper and fusible link ahead of the point where it merges with the supply system.

Air vent inlet opening velocities in classrooms and equivalent rooms shall not be over 300 fpm, and 400 fpm in auditoriums, gymnasiums, shops, toilets and other places where mechanical exhaust is used. Inlets must be placed at the floor, except in shower and locker rooms where inlets must be placed at ceiling height. If possible, locker rooms must be vented through showers.

Wardrobes or lockers in classrooms must have air entry space at the bottom and they must communicate with a vent. When the doors open, they cannot cover the vent. Fifty percent of the ventilation air may be vented through the wardrobes or lockers and 50% may be returned to the main fan by an additional vent in the classroom. For lockers in corridors, no connection to vent ducts is required, except where there are special hazards. Where a classroom has a coat room, the classroom must be vented through that room. The communicating door farthest from the vent opening in the classroom must have the lower part cut off and grilled as for toilets.

The velocity of air in air vent risers (gravity type), as in classrooms, shall not be over 500 fpm; mechanical type, as in toilets, 750 fpm on the inlet side of fan and 1,200 fpm beyond the fan. Risers must be equipped with fire dampers and fusible links. Horizontal air vent ducts (500 fpm for gravity type) are accepted only where shown to be necessary. Air velocities are the same as for risers.

Air movement through gravity type roof ventilators shall not be over 750 fpm. Where built-up types or cupolas are used, only two openings are permitted (on opposite sides in line with the direction of the prevailing wind). Roof ventilators cannot have mechanically operated internal fans, or fans operated by the motion of the vented air. Air velocity through roof ventilators that are part of a mechanically operated vent system, as in toilets, is 1,200 fpm. Venting to atmosphere through outlets in side walls or windows is not permitted.

Dampers are required for control, regulating and balancing the system.

Ozonization is not permitted. Methods and equipment for deodorizing, freshening, or germicidal treatment may be presented to the department for consideration.

Room heater systems are permitted in one-story schools having up to and including 4 classrooms. Such heaters must be enclosed by sheet metal radiation shields having sufficient space between the inside of enclosure and heater to insure free air circulation. The enclosure must extend from 6 inches above the floor to 2 inches above the top of the heater, and must have an outside air connection provided with a damper.

Heating systems not permitted included direct radiator systems or their equivalent for furnishing the total heat in rooms requiring ventilation; single pipe steam systems; hot water systems; warm air furnace systems of common residential type; open gas heater, gas-fired radiators and radiant gas heaters.

Heat may be furnished by either steel or cast iron steam boilers. The department will only accept bonded or recognized association rating in EDR. While steel boilers may be operated above the rating, the amount of this overrating permitted will be governed by good engineering practice.

Heating data required in plans and specifications include kind, type and rating of boiler, kind of fuel, percent of rating developed under 0-70F conditions, length, width and area of grates, square feet of heating surface, recommended size and height of chimney, size and height of actual chimney, engineering data on auxiliaries, pumps, forced draft fans, stokers, oil burners, etc.

Either steel or cast iron boilers of approved design may be used. Only guaranteed conservative ratings in Btu per hour under 0-70F conditions are accepted. Data required in plans and specifications include general description of type, construction and material, dimensions of grates, square feet of heating surface, recommended size and height of chimney, size and height of actual chimney, engineering data on auxiliaries, forced draft fans, stokers and humidifying equipment.

While use of any of the common fuels is acceptable, federal, state and local laws and regulations regarding such use, hazard, fire and/or insurance underwriters' standards must be met. Furnace, boiler and fuel-storage rooms, ladders, means of egress, etc., must

comply with the standards of the Pennsylvania Department of Labor and Industry. For coal, specify the kind, size and approximate heat value in Btu; for oil, specify name and number and approximate heat value in Btu; for gas, specify the approximate heat value in Btu. In case of gas, detailed drawings of all apparatus must be submitted to permit rigid examinations. Air for combustion must be led both to and from the combustion chamber by ample ducts. The heater must be so constructed that there is no possibility of the gas or the products of combustion getting into the air of the building.

Texas

State laws require that in cold weather every classroom or study hall shall be provided with 30 cfm of fresh warm air for each pupil, supplied so as not to place any pupil in a disagreeable draft. The exhaust inlets should be placed at or near the floor line without placing any pupil in a disagreeable draft.

Stoves, radiators or other sources of direct heat in the classrooms or study halls shall be jacketed, ventilated or protected so that pupils seated at desks adjoining such heat sources will not be more than 5F warmer than those seated on the opposite side of the room. An automatic temperature regulator shall be provided that will regulate the room temperature to within 2 degrees of any set standard.

Utah

Although the State Superintendent of Public Instruction is empowered by law to prepare codes governing the heating and ventilating of school buildings, no such code has been prepared. Plans and specifications for school building construction calling for expenditures of $5,000 or more, must be prepared by licensed architects.

Washington

There are no state laws. The following regulations are promulgated by the State Department of Health.

New mechanical ventilation systems must be able to supply 10 cfm of fresh air and 5 cfm of recirculated air per person and to remove an equal amount of air through suitable openings without causing uncomfortable drafts. School buildings which are not provided with mechanical or induced ventilation systems shall have windows which permit openings equal to 25% of the glass area, and adjustment at the bottom, or an equivalent method. There shall be deflectors at the base of the windows to prevent direct currents of incoming cold air from blowing on the occupants. Such regulations do not apply to windows opening on corridors or used for ornamental purposes. The exhaust duct shall be designed to provide a minimum of 1 sq ft of duct area for each 12 pupils.

During the school hours, each room shall be maintained at the design operative temperature by thermostatic controls, and room air temperatures shall be within the range listed in Table 6.

TABLE 6—REQUIRED ROOM TEMPERATURES.

Type of Space	Design Operative Temp., F	Corresponding Room Air Temp., F
Sedentary activity — classrooms, auditoriums, offices, cafeterias	70	68-72*
Moderate activity — corridors, stairways, shops, laboratories, kitchens	68	66-70
Vigorous activity—gymnasiums	65	60-70
Lockers and shower rooms	78	76-80
Swimming pool area	83	80-86

*Temperature reading taken 30 inches above floor. In other areas, 60 inches above floor.

West Virginia

Standards for the heating and ventilating of schools are those of the West Virginia Council on Schoolhouse Construction, approved by the State Board of Education.

For one-story buildings of not more than 6 rooms, the jacketed stove or heater may be used with floor-level, hooded foul air exhaust on the prevailing leeward side of the building. Individual gas-heated steam radiators may be used. Under each jacketed stove or heater there shall be a fire-resisting mat extending at least 15 inches beyond three sides of the unit and 30 inches beyond the feed door side.

In larger schools, plate glass or plastic baffle plate window ventilators should be provided at the base of all windows below which is hung a direct radiation radiator.

Individual exhaust ducts from each classroom may be employed with a central plenum system or a split system combining direct radiation with a central plenum system.

In regular classrooms there shall be a minimum of 10 cfm of fresh air per pupil or 5 air changes for each 2-hour period. In rooms where gas and odors are liberated by operations performed in the rooms, and in toilet and motion picture booths, positive ventilation of at least 6 air changes per hour is recommended during such times as these operations are being carried on.

Trunk lines of pipes and ducts should not run exposed in rooms or in main corridors or in passageways used by pupils. All main headers below the first floor and all horizontal headers shall be insulated.

In planning heating systems and the location of vent ducts, provision should be made for changes and additions which may be necessary because of building extensions. Sufficient boiler room space, fuel bin space and stack provisions should be planned in advance to provide for each additional boiler and furnace installation as may be necessary for future additions. The system should have installed initially, sufficient capacity of steam headers and stack.

Sufficient normal boiler capacity, without overloading, should be installed to heat the buildings to 68F when outside temperature is —10F. Reserve boiler

TABLE 7—VELOCITIES FOR DUCT DESIGN.

Item	Max. Velocity, FPM
Fan—Horizontal ducts	800
Vertical risers	500
Gravity—15 ft or less rise	200
15 to 30 ft rise	250
30 to 40 ft rise	300

capacity should be adequate to carry moderate additional loads.

Pupils' rooms should have sufficient radiation to maintain a normal temperature of 68F; in corridors, gynasiums, shops and toilets, 65F; locker, dressing and shower rooms, 72F.

Low pressure cast iron sectional or steel firebox boilers are recommended, with a recognized and approved type of smokeless furnace. For larger units, stokers are recommended where stoker fuel is available. If gas or oil is used for fuel, appropriate furnace design shall be specified.

If direct radiation is used, radiators of the wall-hung type should be placed beneath windows. Insofar as possible, radiators should be of a length corresponding to the width of the single sash directly above them, and faced with radiator shields extending 2 inches above, below, and on each side of the radiator, to provide for better circulation in the room, and to protect nearby pupils from immoderate heat.

Where the unit system or the plenum is used, the system shall be no adjusted and automatically controlled as to provide from 0 to 80% recirculation. Recirculation of air between rooms will not be approved.

Whenever possible, automatic temperature control should be provided. Auditoriums, gymnasiums, shops, community rooms, and other parts of a building likely to be used by the general public outside of school hours should be individually zoned for independent temperature control.

A separate flue should be provided for each of the following: Central heating boilers, furnaces or stoves; unit room heaters, except those using natural gas or electricity; incinerators or trash burners; hot water heaters, except those using electricity; cooking stoves, except those using electricity.

Where essential for health, comfort and working efficiency, positive ventilation should be provided. Where direct radiation, window supply system, unit system, or a combination of these is employed, special duct ventilation shall be provided for laboratories, shops, kitchens, food laboratories, cafeterias, auditoriums, projection booths, locker rooms and shower rooms. Fume hoods of acid-resisting material, with positive ventilation, shall be installed over stoves in kitchens and in chemistry laboratories. Air from laboratories, paint and finishing rooms, kitchens and toilets shall be exhausted above the roof line.

In general, vent grilles shall be set into walls at the floor line. Intake grilles for unit systems shall be lap-louvered against the elements. Where foul or exhaust air ducts are used, it is recommended that grille screens be omitted in the interest of cleanliness. Floor grilles should not be used. Ceiling grilles are permissible only for ultimate exhaust at the top of a building, unless special conditions urgently recommend them.

Fresh air intake for central heating plants should be at least 10 ft above ground level. This is especially desirable where filters are not employed.

Where ducts or flues are used, each classroom shall be served by an individual duct, which may, however, feed into a trunk line serving other rooms. Sizes of ducts shall be based on velocities in Table 7.

Only wide-spaced coil accelerators are recommended for gravity ducts, and only when operating conditions necessitate their use.

Exhaust openings shall be adequately protected against weather and backdrafts by ventilator caps, heads, or other satisfactory devices which shall be at least as high as copings and other elevated roof sections, except chimneys. Attics shall have lap-louvered vents sufficient to provide free circulation of fresh air.

Ventilation fans, not conveniently accessible, shall be controlled by pilot light switches located in the principal's office and in the custodian's room.

Wisconsin

The code of regulations are those published and enforced by the Industrial Commission of Wisconsin.

In auditoriums and gymnasiums and similar occupancies having a ceiling height in excess of 20 ft, the air supply is based on 6 air changes per hour. In any assembly hall for which a fire curtain is required, sufficient air shall be supplied on the stage to equalize the air pressure to avoid deflecting the curtain. Playrooms of rural schools need only be provided with a positive exhaust.

The total primary air circulation in recitation, study, lecture, project rooms and library reading rooms in schools and colleges shall not be less than 30 cfm per occupant or 6 air changes per hour. The larger of these two quantities is to govern. The outside air supply during occupancy shall be not less than 10 cfm per occupant and shall be taken from a relatively uncontaminated source outside of the building. Adequate controls shall be provided. Corridors and halls shall be supplied with not less than 10 cfm of air per linear foot of corridor.

Where a school has not more than 2 classrooms, the capacity of the heating and ventilating systems may be based on service to classroom floors only; where basement apparatus is used, arrangement is to be made for alternate service to basement areas if used for occupancy.

In domestic science rooms, shops and laboratories, exhaust ventilation shall be provided for use with equipment and processes that may create dusts, fumes, vapors or gases injurious to persons so exposed.

Wyoming

No legislation governing heating and ventilating. Matter is entirely under the jurisdiction of the local school board and the architect or engineer it employs.

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

This Month's Problem

What is the best location for a steam trap when the condensate has to be elevated to an overhead return main?

IN the box on top of this column is the industrial plant problem that is discussed in this issue. The answer published is through the courtesy of an engineer who has had considerable experience in solving steam trap problems.

Do you have a problem that you would like to see treated in this department? Do you have a solution to the one scheduled for future discussion? The Editor cordially invites such letters.

Suggested Solutions

A correct answer to this question cannot be given without knowing the actual conditions of steam pressure, height of return main, the type of equipment being drained, and the type of steam trap advocated. Some types of steam traps appear to operate equally well in any position, while others will give satisfactory results only when located below the equipment being drained.

Fig. 1 illustrates an actual hookup where a float

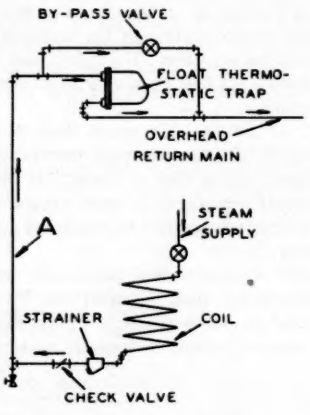


FIGURE 1

INCORRECT INSTALLATION

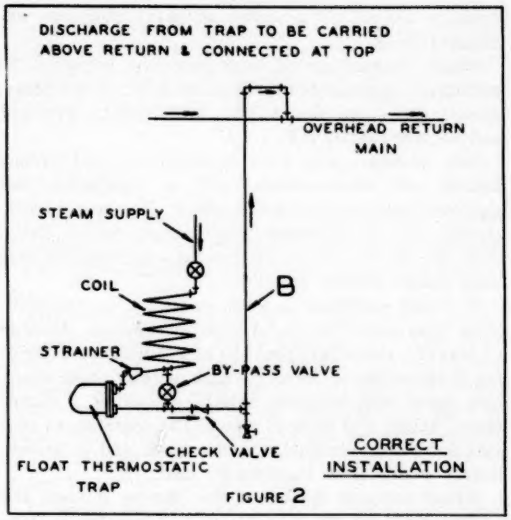


FIGURE 2

trap was installed at high level and gave continual trouble because water could not be effectively cleared from the coil, and the trap only operated at fairly long intervals instead of giving a continual discharge. With the float trap at high level, as illustrated, it was found that under certain conditions the float discharge valve would close after the first and any subsequent discharge, and with a closed valve no water could enter the trap regardless of the pressure inside the coil. It seemed that under such conditions the trap would remain closed until the thermostatic air vent element cooled sufficiently to open and allow some water to pass through the air by-pass into the trap body. This

Problem to be Discussed

July Issue

What is a good empirical rule-of-thumb to use in figuring the hourly air change in a textile mill in the summer? This air change should be only that caused by infiltration and exfiltration around and through doors and windows and through walls of a completely unconditioned mill. What would be the effect on such air change of the increased vapor pressure inside the mill caused by mechanically introduced water vapor, as in a standard humidifier system?

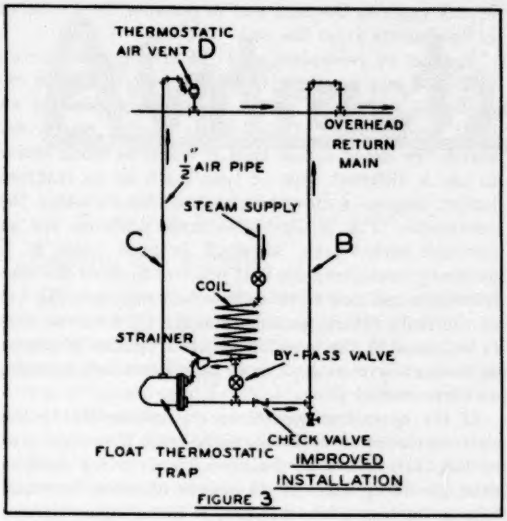


FIGURE 3

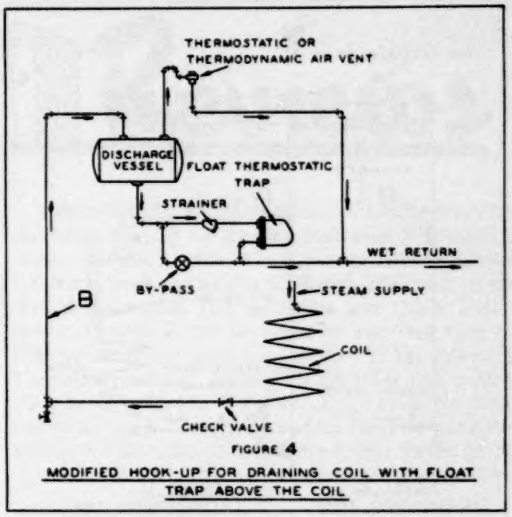


FIGURE 4

MODIFIED HOOK-UP FOR DRAINING COIL WITH FLOAT TRAP ABOVE THE COIL

water would lift the float, thereby opening the discharge valve and allow water to pass freely from the coil through the trap.

After all the water was discharged and steam again reached the air vent, the trap closed again and remained closed until another cycle took place with the cooling down of the air vent. It would, of course, be possible to use some device to allow steam in the pipe *A* to leak through the trap into the overhead return main, but this is not considered good engineering practice, particularly if a safer remedy can be effected. In this case, the same trap was placed below the coil, as shown in Fig. 2, and everything was found to be perfectly satisfactory.

The correct position for a float trap is unquestionably below the coil or unit to be drained, because in this position the condensate can gravitate into the trap quite freely, and as the water enters the trap body the float is raised which opens the discharge valve and allows the pressure within the trap to lift the condensate to the overhead return. It is always advisable for the discharge pipe *B* to be carried above the return main as illustrated, especially when the main is conveying condensate from other traps. This assures that any condensate traveling along the return main does not flow back down the pipe *B* and add to the work of the trap.

An improved method for such an application is shown in Fig. 3. This arrangement corresponds very closely to Fig. 2, except that an air vent pipe *C* is connected to the top of the trap body and carried above the main return with a thermostatic air vent *D* inserted. With this arrangement, air or any incondensible gases entering the trap is allowed to pass freely into the main return without retarding the flow of condensate; whereas, with the arrangement as shown in Fig 2, the air has to be forced through the water collected in the discharge pipe from the trap, and also through the water which will accumulate in the rising part *B*.

If a float trap must be used, and it is impossible to install the trap below the coil, a compromise hook-up may be made similar to the illustration shown in Fig. 4, which has proved quite successful. With this arrangement an elevated collecting chamber is installed above the float trap with a thermostatic or other equivalent air vent for releasing air from the tank into the main return. The condensate which is formed in the coil or other equipment, will be elevated to the collecting tank and can then gravitate through

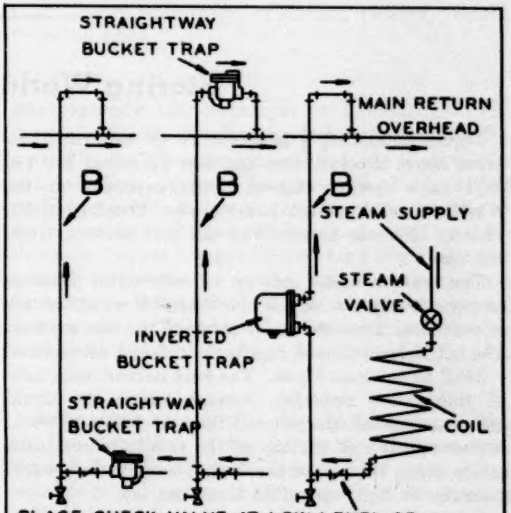


FIGURE A FIGURE B FIGURE C

FIGURE 5

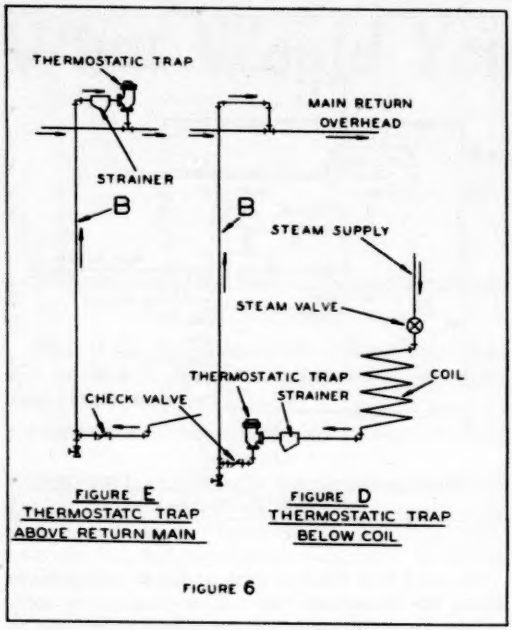


FIGURE 6

the float trap to the main return. Should it be imperative to resort to this type of hookup, the collecting chamber should have a capacity of not less than six times that of the trap body and not less than 3 gal. The collecting chamber and connecting pipes are usually left uncovered to accelerate the condensation of any vapor in the tank and to promote the discharge of condensate from the coil.

It must be recognized that the arrangement shown in Fig. 4 is a compromise only to overcome some exceptional conditions, and is not recommended as an ideal arrangement. Unless some special reason demands the use of a float trap, it would be much better to use a different type of trap, such as an inverted bucket trap or a thermostatic trap for elevating the condensate. Fig. 5 illustrates three positions for an inverted bucket trap, although in most cases it is generally considered the best practice to place the trap below the coil and elevate the condensate into the top of the main return, as shown at *A*. If, however, this is not possible, the inverted bucket trap may be placed at the high level as at *B*, or in an intermediate position as illustrated at *C*.

If the operating conditions are conducible to the characteristics of a thermostatic trap, then this type of trap can invariably be used for elevating condensate, providing there is no danger of water hammer. Fig. 6 illustrates two methods of installing a thermostatic trap for this purpose. While in many cases either position often proves successful, it is found that less trouble develops from water hammer if the thermostatic trap is placed at the high level, as illustrated at *E*. In all cases, however, it is advisable to carry the vertical discharge pipe to above the main return, regardless as to the position or type of trap used.

T. Napier Adlam, Vice President
Sarco Manufacturing Co.
New York, N. Y.

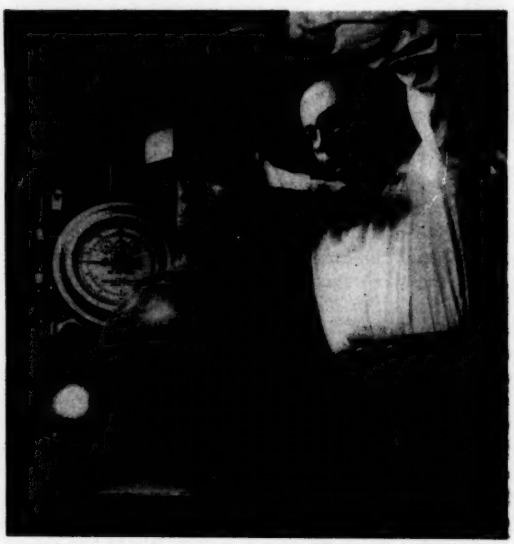
Storing World's Coldest Liquid

Liquid helium at a temperature of only eight degrees above absolute zero can now be stored for 100 days in a special vacuum bottle developed at the Westinghouse Research Laboratories, Pittsburgh, Pa. This is 15 times longer than the best previous storage time.

The vacuum bottle consists of two highly polished copper spheres, one inside the other. Most of the air is evacuated from the space between the two spheres. The bottle is immersed in a tank of liquid nitrogen at —300F to cut heat losses. The long narrow neck tube of thin-walled material, through which the liquid helium is poured, has reduced the heat inflow by 90%. A tiny opening at the top of the container acts as a safety valve to release the high pressure that would normally be built up within the container.

It is believed that this container may bring about a radical change in present shipping methods for such refrigerants. Savings will be achieved both in space and in the materials which were formerly required.

Dr. Aaron Wexler, head of Westinghouse low-temperature studies, collaborated with Howard S. Jacket of Hofman Laboratories, Newark, N. J., in the design of this vacuum bottle that holds 4 gal of liquid helium.



Vacuum bottle removed from tank container.

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

DOMESTIC OIL BURNERS

Since proper installation and servicing of domestic oil burners depends on an understanding of not only the oil burner itself, but the many factors that influence its operations, those concerned with the functions of installing and servicing will appreciate having such information in one volume.

Charles H. Burkhardt, heating editor of the *Sheet Metal Worker*, and also *Plumbing and Heating Journal*, in writing this book has drawn on a series of articles on oil heating that appeared in both publications, and upon his experience in conducting vocational education and laboratory work.

The 33 chapters are grouped in three divisions—domestic oil burners, installation and controls, and service and maintenance. Proven procedures are given for correctly sizing, designing and building fireboxes, and steps given for making a complete heating survey. Controls are extensively covered, including recent developments in electronics and burner-mounted controls. Fourteen chapters are devoted to service and maintenance.

Domestic Oil Burners, by C. H. Burkhardt. Cloth bound, 6 x 9 inches, 359 pages. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price, $6.

DIMENSIONAL ANALYSIS AND THEORY OF MODELS

A systematic treatment of the principles of dimensional analysis is undertaken in this book, by Henry L. Langhaar, professor of theoretical and applied mechanics, University of Illinois. Dimensional Analysis treats the general forms of equations that describe natural phenomena. The result of a dimensional analysis of a problem is a reduction of the number of variables of the problem, thereby amplifying the information that is obtained from a few experiments. Applications abound in nearly all fields of engineering, particularly in fluid mechanics and in heat transfer theory.

Separate chapters are devoted, respectively, to applications of dimensional analysis in stress analysis, fluid mechanics, thermal problems and electrical problems. There is also a chapter on the method of deriving model laws from the differential equations that govern particular phenomena.

Dimensional Analysis and Theory of Models, by H. L. Langhaar. Cloth bound, 6 by 9 inches, 166 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $4.

METAL CLEANING BIBLIOGRAPHICAL ABSTRACTS—The American Society for Testing Materials has issued a 1950 supplement to the Metal Cleaning Bibliographical Abstracts prepared by Jay C. Harris, chairman of the ASTM Committee D12 on Soaps and Other Detergents. References are arranged by year and then by author. Abstracts have been indexed in the following four ways: subject, author, specification and patent. This booklet, Special Technical Publication No. 90A, covers 27 pages. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $1.00.

FINDING PRESSURE CHARACTERISTICS OF A FURNACE BLOWER—A test program conducted with the cooperation of the University of Illinois Engineering Experiment Station and the National Warm Air Heating and Air Conditioning Association, was started in 1946 to determine an arrangement and procedure for obtaining pressure characteristics of a blower used in conjunction with a furnace. Tests conducted with a hi-boy furnace indicate that each combination of blower and furnace requires an individual test. Results of this study are available as Engineering Experiment Station Bulletin, Series No. 390, prepared by N. A. Buckley, S. Konzo and R. W. Roose. The Engineering Experiment Station, University of Illinois, Urbana, Illinois. Price, 50 cents.

MEASUREMENT AND SAMPLING OF PETROLEUM — The American Society for Testing Materials has issued a manual on the measurement and sampling of petroleum and petroleum products that consists of six ASTM methods required to measure and compute quantity of oil in storage and transportation tanks, and also for obtaining typical samples of the tank contents. The methods included cover gaging, temperature measurement, volume calculations, water and sediment, gravity, and sampling. Published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

METALLURGY AND PIPING—The Metallurgy and Piping Sub-Committee of the Prime Movers Committee, Edison Electric Institute, has issued a report on metallurgy and piping which covers high temperature materials, high temperature pipe welding and fabrication specifications, graphitization, valve outages and miscellaneous information. This report of 42 pages contains a number of questions and answers, and statements by operating companies. Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y. Price, $2.25 to non-members and 90 cents to members and their employees.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite Page 110 for securing additional information on items described in this department.

Non-Critical Warm Air Ducts

A development for use in warm air heating systems is announced by Sonoco Products Co., Hartsville, S. C. This product is a fiber duct which, when embedded in concrete floor slabs, is used as a supply or return line in radial or perimeter warm air heating. The duct has been named Sono-airduct.

The duct is said to be more economical to use than metal, glazed tile, or concrete blocks, not only on account of its original cost but because of low installation charges. The latter is due to its lightness in weight and the long lengths in which it is available, thus allowing ease in leveling, manipulating and fitting.

This duct will not delaminate when placed under water or exposed to excessive moisture. It is fire resistant, has a high crushing strength and will stand rough handling and weathering.

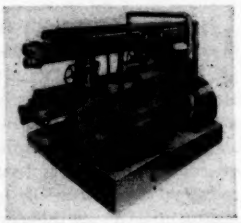
The ducting is available in lengths up to 25 feet and in inside diameters from 2 inches up to and including 24 inches. It can be shipped in the lengths desired by the user or shipped in the standard 18-foot lengths and cut to proper lengths on the job. This cutting can be done with a hand saw or a power saw. A 4-foot length of 8-inch duct weighs 6½ pounds.

Bends, elbows, or tees cannot be made economically from paper or fiber, so that metal fittings are used.

For more information, circle on Inquiry Card, **Item 1**

Reciprocating Compressors

Two models of reciprocating refrigeration machines, specifically designed for air conditioning and refrigeration use in the 100 to 150 hp range, are announced by Carrier Corp., Syracuse, N. Y.



The reciprocating machine, designated as the Model 30B, is furnished as a complete package with compressor, cooler, and condenser, and all interconnecting piping, fittings, safety and capacity controls, gage board, and cooler and condenser stands included. Careful pre-engineering has assured precise matching of components for maximum operating efficiency and economy. Unusual compactness of assembly, provided through special design of pipes and fittings, reduces pressure loss to a minimum, guarantees better over-all performance, and permits a wide range of applications where space is critical. The machine is particularly suitable for chilling water for air conditioning purposes, and is readily adaptable to many industrial requirements, including direct product cooling, brine chilling, and ammonia and chlorine condensing.

For more information, circle on Inquiry Card, **Item 2**

Large Boiler Relief Valves

Assemblies, consisting of two or three McDonnell Series 33 safety relief valves, have been developed for adequately safeguarding larger hot water heating boilers from excessive pressure, according to McDonnell & Miller, Inc., Chicago, Ill.

Explaining the introduction of the assemblies, the manufacturer calls attention to the A.S.M.E. boiler code recommendations for equipping hot water heating boilers with relief valves having tested and rated discharge capacity equal to the gross Btu output of the boiler. This requirement is met by the No. 33 relief valve for all boilers having a gross heat output up to 242,900 Btu per hr—approximately 70% of all hot water boilers. However, there still remains the 30% of larger boilers to which proper protection is equally essential, and it is for these larger boilers that the assemblies were developed.

The assemblies give a discharge capacity equal to the sum of the capacities of the two or three valves: No. 233 two-valve assembly, total discharge capacity 496,700 Btu per hr; No. 333 three-valve assembly (illustrated), total discharge capacity 769,400 Btu per hr. Assemblies consisting of proper size valves and manifold are packaged completely made up and ready to install.

Two or three smaller valves with small size orifices are preferable to larger orifice valves of equal capacity because the use of smaller valves circumvents the objectionable excessive discharge which characterizes large-orifice relief valve when called upon merely to discharge the small amount of surplus water produced by expansion.

With these assemblies, when the boiler pressure reaches 30 lb per sq in. only one valve opens, and opens only enough to take care of normal thermal expansion. If, however, a runaway firing condition occurs, causing a steaming and excess pressure condition, the two or three valves open in progressive succession, providing full rated discharge capacity of the assembly.

For more information, circle on Inquiry Card, **Item 3**

Evaporative Cooler Pad

Coolpad, an evaporative cooler pad material, is introduced by Research Products Corporation, Madison, Wis. This pad material, available in blanket form from which pads of required size can easily be cut, is said to be completely uniform and has maximum flexibility in application. It is claimed that it has a high evaporative efficiency and a low, clean resistance to air flow.

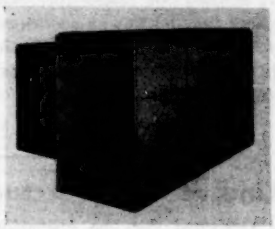
The material is made from layers of refined cellulose fiber strengthened with a plastic with added reinforcing metal. There are no particles to break loose and damage pumps or drains. In use, under normal conditions, the pads are free from odor.

A standard size roll measures 20 x 40 x 2 inches. Pads of the size required are easily cut from the roll as desired. Little or no waste is encountered because smaller pieces can be butted together and used with no loss in performance.

For more information, circle on Inquiry Card, **Item 4**

Gas-Fired Heating Units

Addition of five new high input sizes to its line of Type 105 gas-fired winter air conditioner is announced by L. J. Mueller Furnace Co., Milwaukee, Wis. The new sizes are: 300,000, 360,000, 450,000, 540,000 and 675,000 Btu per hour input. The new sizes were especially developed for heating larger residences, apartments, schools, churches and commercial buildings.



All sizes of the Type 105 are approved by AGA for use with natural, mixed and manufactured gas. The units have been approved for high altitude installation with full rating on these gases. In addition, they are approved for use with liquefied petroleum gas, 500 to 800 Btu propane-air or butane-air gases, and 800 to 1400 Btu propane-air or butane-air gases at full input rating.

The construction of the new sizes is similar to that of the older models, except more than one heat exchanger is employed under one casing. A standard blower-filter unit is used, together with a transition piece at the back to connect the furnace casing and the blower-filter unit. The units employ one gas burner manifold with individual safety valves and pilots for each burner.

For more information, circle on Inquiry Card, **Item 5**

Electric Oil or Water Heaters

As the capacity of electric heating equipment is made higher, more and larger jobs for this type of equipment result. One of the latest important developments, large Chromalox electric circulation heaters, fully insulated and with built-in automatic temperature control, is announced by Edwin L. Wiegand Co., Pittsburgh, Pa. Illustrated is a 40 kilowatt size for preheating fuel oil to approximately 170 deg. Similar electric circulation heaters can be used for preheating the viscous but low cost Bunker C oils. Heating this oil makes it free-flowing from storage reservoirs — and it also increases the efficiency of combustion.

These packaged electric heaters are connected for economical heating of large quantities of water or other media. When operated at off-peak hours, large quantities of water can be heated economically and kept in storage tanks for use during the working day. A typical use is the heating of water for factory shower rooms, particularly during summer months when the central heating systems are not operated.

The heaters are constructed of heavy steel pipe housings which enclose Chromalox tubular heating elements. The heating elements are alloy sheath for most heating jobs, but copper sheath for heating water. For most efficient operation, baffles are provided in the housing whenever the heater is operated under forced circulation. Thermostats with close temperature control are available, both for the forced-circulation-type and the natural-convection-type.

For more information, circle on Inquiry Card, **Item 6**

Plate Type Heat Exchanger

Development of a new plate type heat exchanger, especially designed for solvent recovery, is announced by Modine Manufacturing Co., Industrial Division, Racine, Wis.

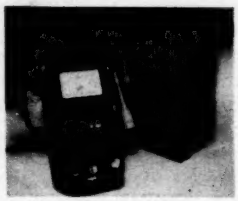
Incorporating interlocked channel type fins with special embossings or interrupted surfaces, the new design provides high concentration of surface for low weight and volume. Surface area ranges from 250 to 300 square feet per cubic foot. Use of the design permits attainment of very low terminal temperature differences.

The units are designed for easy assembly into blocks to accommodate a wide range of capacity requirements. Individually engineered to meet particular needs of each processing application, these units are offered where quantity requirements warrant production.

For more information, circle on Inquiry Card, **Item 7**

Pocket-Size pH Meter

A revolutionary pocket-size pH meter and companion probe unit, permitting instant, on-the-spot pH determinations anywhere, has been developed by Analytical Measurements, Inc., Chatham, N. J.



Completely self-contained, with batteries in a bakelite case 3x5⅞x2½ inches, this instrument is furnished in a case with plastic tubes of buffer and KC1 solutions. Total weight is 8 lbs. Both waterproof and fungus-proof, the case comes with a combination hand-and-shoulder strap, allowing the instrument to be slung over the shoulder or hung around the neck leaving both hands free.

Supports and beakers are completely eliminated by combining the calomel and glass electrodes with the sample holder, in a single polyethylene probe unit.

The meter is scaled from 2 to 12 pH for easy reading, and a simple adjustment gives readings from 0 to 14. Accuracy of 0.1 pH is obtainable. Hearing-aid type batteries provide up to 1,300 hours of operation.

For more information, circle on Inquiry Card, **Item 8**

Fuel Oil Deodorant

Designed to eliminate the objectionable odor of fuel oil after a serviceman's visit or to the overflow of tanks in the basement, a product called Neutroda has been introduced by The Tankit Co., Newark, N. J. The serviceman simply sprinkles the product from its handy shaker container onto the source of the leak and it instantly neutralizes the oil and destroys the odor. If the leak is inaccessible, the product can be diluted and poured or sprayed on the leak. Oil truck drivers also find it valuable to carry the deodorant to combat any oil spillage.

In addition to banishing fuel oil odor, Neutroda will remove most oil stains. It is itself completely odorless and is non-inflammable, non-corrosive, non-irritating, non-volatile and non-toxic.

For more information, circle on Inquiry Card, **Item 9**

Suspended Oil Heaters

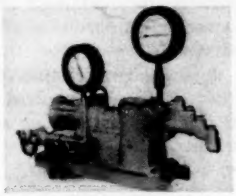
Addition of three models of suspended type oil-fired winter air conditioners in three sizes to its line of automatic heating equipment is announced by York-Shipley, Inc., York, Pa. The units use the iris shutter type burner but have been designed as complete units for greater economy and efficiency.

Output at bonnet of the three sizes are 115,000, 150,000, and 205,000 Btu per hour. Each model is finished in white to match the other units in the 1951 line. The suspended units can be used in garages, service stations, attics, crawl spaces, stoves or wherever space is at a premium. Jacket sizes range from 26 inches square by 61 inches long for the smallest model to 33 inches square by 88 inches long for the longest.

For more information, circle on Inquiry Card, **Item 10**

Hydrostatic Test Unit

The aiROYmetric pressure generator has been developed for a broad field of hydrostatic test applications, by Milton Roy Co., Philadelphia, Pa.



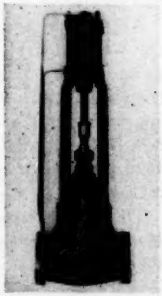
The unit is combined with a group of specially designed simplified controls to develop test pressures from 25 to 25,000 lb per sq in., using ordinary plant air supply in the pump cylinder. Each of the pumps develops a discharge pressure ratio range of at least 6 to 1, permitting single pump use for applications requiring various test pressures.

The pressure generator has use in the hydrostatic testing of boilers, forgings, castings, tubing, pipes and piping systems, pressure gages, valves, vacuum pumps, dryers, and high pressure hose, among others. It is used for filling refrigerants and other liquefied gases into bottles or containers. It has application as a booster pump for maintaining required pressures in hydraulic systems. Capacities range from 4 to 405 gallons per hour.

For more information, circle on Inquiry Card, **Item 11**

Line of Valve Actuators

Designed for the operation of gate valves, plug valves, dampers, diaphragm valves, butterfly valves and sluice gates, and developed as a standard product, is a line of valve actuators introduced by Ledeen Mfg. Co., Los Angeles, Calif.



These actuators are basically Ledeen cylinders, equipped with brackets, valves, controls, and couplings to make them suitable for almost any type of operation required. They can be adapted to any make, size, and type of valve; to operate against any line pressure; to work on any fluid medium, and with any pressure available. They can be arranged for on-and-off service, or for positioning service.

For more information, circle on Inquiry Card, **Item 12**

Stainless Steel Pump

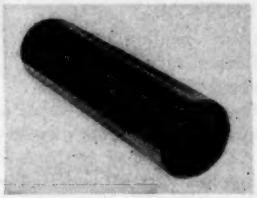
Designed for the chemical, process, food and other industries, a small centrifugal pump, with all wetted parts constructed of Type 316 stainless steel, is announced by Bell & Gossett Co., Morton Grove, Ill.

The new pump is constructed in ¾ to 1½ inch discharge, and horsepowers run from ¼ to 2. It has all of the features of the regular line of B & G Series 1522 centrifugal pumps, including a leak-proof mechanical Teflon seal, standard motor, hydraulically balanced impeller and spring-type flexible coupling. The unit is easily serviced. Removal of a few bolts permits separation into three parts.

For more information, circle on Inquiry Card, **Item 13**

Longitudinal Finned Tube

The Heat-X longitudinal fin tube is being marketed by Heat-X-Changer Co., Brewster, N. Y. Designed for a high rate of heat transfer between liquids and gases, the tube has the advantage of maximum heat transfer with minimum pressure drop.



The surface is available with one or two finned annular spaces with outer tubes ranging from ⅝ to 2⅛ inches and inner tubes ¼ to ¾ inches. Standard tubes are of copper, with copper or aluminum fins. Tubes are available in finned lengths up to 10 feet in 6-inch increments.

For more information, circle on Inquiry Card, **Item 14**

Power Roof Ventilator

The Type PRV power roof ventilator, suitable for schools, hospitals, apartment buildings, commercial buildings and industrial plants, is introduced by Ilg Electric Ventilating Co., Chicago, Ill. The unit is offered in eleven sizes, each size available in two to four different speeds. For extra quiet operation, low speeds are available in each of the sizes.

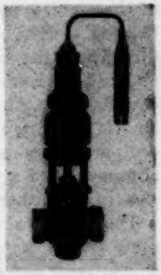
The new unit, consisting of a housed direct-connected centrifugal fan and motor, features positive controlled ventilation independent of wind or weather conditions in sizes providing air deliveries over the unusually large range of pressures from free air to 1½ inches static pressure.

Heart of the ventilator is its self-cooled motor. Positive pressure ventilation is provided to cool the motor and motor compartment with cool, clean outside air. The weather-tight housing contains the complete fan unit and air control accessories, eliminating the need of an expensive high-profile curbing and fitting of air control accessories into the roof or curbing section. The ventilator is easily and quickly installed, wired and serviced.

For more information, circle on Inquiry Card, **Item 15**

Temperature Regulator Dial

A calibrated dial for use with its Class T and Class M type temperature regulators is announced by Leslie Co., Lyndhurst, N. J. The dial is time saving in that a quick turn of the dial to the desired setting is all the attention that is necessary. There is no need to wait for the equipment to heat up to find out if the setting is correct.



The dial is also said to provide protection against costly overheating caused by guess setting. In addition, it is designed for long life under rugged operating conditions, such as production line use where frequent readjustments are necessary for process work.

For more information, circle on Inquiry Card, **Item 16**

Suspended Oil Furnace

Designed for installation in homes, garages, stores, service stations, warehouses and factories, the Wondaire suspended oil furnace is available in eight models, ranging from 80,000 to 500,000 Btu per hour output at the bonnet, according to the maker, Cox Mfg. Co., Ridgeville, Ind. Finished in Hammerloid two-tone gray, the unit is shipped completely assembled with thermostatic and safety controls and hanging rods, cutting installation costs materially.

The heat exchanger is electric welded and of tubular construction, permitting the blower to force an uninterrupted air flow through the unit. The pre-cast refractory is built to withstand temperatures up to 2,800 degrees and overlaps sufficiently into the heat exchanger to prevent any possible flame impingement. Only ninety seconds after the burner comes on, the blower begins pumping warm air for rapid space heating.

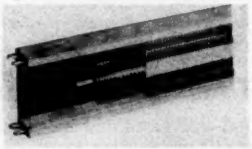
The high pressure, gun-type burner is fed by a two-stage pump which forces the fuel through long lines and high lifts with ease, providing utmost cleanliness around and under the furnace. Both the blower and motor are mounted free of the furnace jacket, preventing vibration noises.

For more information, circle on Inquiry Card, **Item 17**

Baseboard Fits on Framework

A type of baseboard radiation that can be easily and quickly installed on the rough framework of a house or building and the installation completed while all piping is accessible for testing, is announced by Minimite Co., Chicago, Ill.

Convect-O-Base, as it is known, requires no special tools or equipment for installation and harmonizes with the finest interiors.



The radiation consists of three units; back cover, heating section, and front cover. The back cover nails directly to the studs or furring strips on new work, and can be recessed or flush mounted on remodeling installations. It can be readily cut to any desired length, or mitered to fit any angle or corner, with an ordinary cross-cut saw. Dowelled ends assure fit and alignment and a universal end stop provides matching closure for either end.

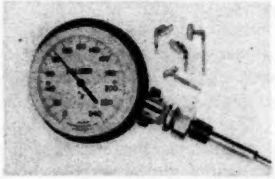
The heating sections mount on self-locking pipe supports which are included and fit into holes provided in the back cover. The sections can be easily shortened, if desired, by cutting the copper tubing with a hacksaw and snipping off a few aluminum fins.

The front cover slips into the upper slot of the back cover, then drops into the lower slot where it locks in position. It is removed at any time without disturbing the wall, quarter round or back cover. It consists of an attractive metal grille that can be readily cut to any desired length, thus short pieces can be used in front of valves or air vents for easy access, if desired.

For more information, circle on Inquiry Card, **Item 18**

Adjustable Dial Thermometer

A line of mercury actuated dial thermometers has been introduced by Palmer Thermometers, Inc., Cincinnati, Ohio. A feature is that the stem can be placed at any angle and the case rotated to any readable position.



The thermometer has a 4½ inch dial with a non-reflecting white face. The case is dust, vapor and waterproof and fully compensated for ambient temperatures. The armor is flexible, of 18-8 stainless steel, available in standard length of 5 feet with a maximum length of 60 feet.

For more information, circle on Inquiry Card, **Item 19**

Asbestos Duct Connection

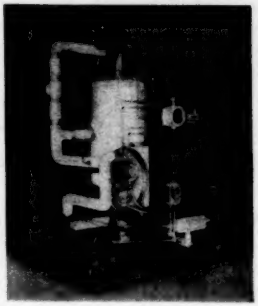
An all-asbestos flexible duct connection, to stop noise travel and vibrations from automatic or mechanical forced air heating, air conditioning and ventilating equipment, has been announced by Grant Wilson Inc., Chicago, Ill. It has both edges selvaged to prevent fraying or unravelling and lasts as long as, if not longer than, the mechanical equipment itself.

The asbestos flexible duct connection is easy to install with sheet-metal screws, clips, metal bands or fastening bolts. It is fire-proof and has great tensile strength. A free sample and literature are available.

For more information, circle on Inquiry Card, **Item 20**

Dowtherm Heat Transfer Units

A new standard line of electrically heated Dowtherm heat transfer units has been developed by Struthers Wells Corp., Warren, Pa. Supplied complete with instruments, piping, insulation and other accessories, these units are ready for immediate use upon delivery.



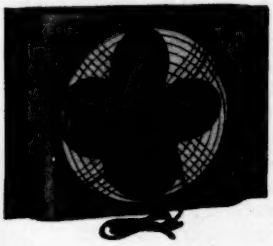
With capacities ranging from 100,000 to 500,000 Btu per hour, these heaters have a temperature range to about 750F, using Dowtherm as a liquid or vapor medium. In addition, other heat transfer fluids may be utilized in this equipment.

The unit may be base mounted at the factory or supplied with all essential equipment for your mounting. Units include a special heating element, designed to eliminate thermal breakdown or coking troubles.

For more information, circle on Inquiry Card, **Item 21**

Reversible Window Fan

A new Fresh-air Maker reversible 20-inch window fan, Model RW-20, has been introduced by Schwitzer-Cummins Co., Ventilating Division, Indianapolis, Ind. It is available with two speeds for both exhaust and intake, the motor being electrically reversible. To change the direction of air flow it is only necessary to flip the reversing switch.



The fan is said to have equal air flow whether moving air in or out. The fan blade assembly is rubber mounted.

Fan diameter is 20-inches and the height of the whole unit is 24 inches. The fan has a rating of 2900 cfm at high speed and 2400 cfm at low speed, NEMA ratings; and 2300 cfm and 1900 cfm at high and low speed, respectively, NAFM ratings.

For more information, circle on Inquiry Card, **Item 22**

All-Rubber Centrifugal Pumps

A line of small centrifugal, all-rubber pumps, for handling both corrosive and non-corrosive liquids, and powered by tiny electric motors of from 1/200 to 1/35 hp, is announced by The Gorman-Rupp Co., Mansfield, Ohio. The pumps are of a size to be held on the flat of the hand, and weigh from 2 to 4 pounds. They are available as all-rubber pumps or as rubber and bronze or zinc.

There are three types: motor-driven enclosed and skeleton units, and belt-drive units. Three sizes of each are available. The over-all capacity range is from 504 gallons per hour at 2 ft head to 78 gallons per hour at 10 ft head. Both series are identical in power and dimensions.

Design of these pumps features a molded rubber volute and a rubber impeller molded to a stainless steel shaft which is mechanically connected directly to the motor shaft. A diaphragm and seal combination of molded rubber completely covers the metal-supporting member that joins the motor and pump structures. The stainless steel shaft is the only metal in contact with the liquid being pumped.

For more information, circle on Inquiry Card, **Item 23**

Ultra-Violet Air Purifier

The Vita-Aire air purifying unit has been introduced by Vita-Aire Division, Hydro Aire Corp., Waukesha, Wis. It purifies the air by passing it through an ultra-violet field, oxidizing all organic matters, such as smoke, gases and odors. It also reduces the quantity of bacteria present.

The unit is designed to be installed in any air duct or air conditioning unit for any building, including homes. It has low initial cost and is economical to operate. Portable units are available, to be used where there are no ducts. The portable unit may be placed conveniently and plugged into any 110-volt a-c outlet.

For more information, circle on Inquiry Card, **Item 24**

New Odor Counteractors

A new line of industrial odor counteractants, called Reductors, has been added to the products of Airkem, Inc., New York, N. Y.

Many offensive industrial odors can now be effectively neutralized through the application of these reductors, and objectionable odors which persist in certain consumer products can now be permanently neutralized. Each of the new formulas is especially compounded to meet a specific industrial odor problem. The formulations follow the basic odor neutralization principle of opposing odors, by which over a period of years the company has demonstrated that many disagreeable odors can be effectively reduced or counteracted.

More than 40 new reductor formulations have been thus far developed to work against a like number of offensive smells, particularly the stench of putrefaction. The highly unpleasant odors caused by manufacturing processes, such as products and by-products stemming from the use of oils and fats in rendering and dehydrating can in many cases be effectively eliminated.

For more information, circle on Inquiry Card, **Item 25**

Air Pollution Analysis

A new instrument for use in analyzing air-pollution problems in highly industrialized areas has been developed by Battelle Institute, Columbus, Ohio. Because it will tell the direction from which large quantities of dirt come, it is expected it will be useful to industries and municipalities in locating the sources of air-pollution nuisance.

Known as a "directional dirt-fall collector," the instrument provides an index of the general location of plants which may be responsible for heavy dirt fall. It will evaluate, for example, the amounts of dirt blown from across surrounding rivers as well as the amounts of dirt originating directly from the locality.

The dirt-fall collector, which will be made commercially available by Eberbach & Son Company, Ann Arbor, Mich., is designed to collect heavy dirt from any direction the wind is blowing. For a reliable indication of the sources of heavy contamination the instrument must be exposed for 30-day collection periods over many months in a carefully chosen location representative of a given area. The amounts of collected material must be correlated with data obtained from the Weather Bureau. A so-called wind-rose pattern shows the number of hours the wind has blown from the eight points of the compass. Knowing this, it is then possible to determine the relative amounts of dirt which have fallen per hour into the instrument from the various directions.

For a complete dirt-fall collection program, several directional dirt-fall collectors are required, Dr. Munger points out. Simultaneously, fine particles (aerosols) and gas and odor concentrations in the air, along with weather conditions, may be analyzed using other appropriate instruments and equipment.

For more information, circle on Inquiry Card, **Item 26**

Residential Air Conditioner

Increased production of a new year-round residential air conditioning unit, designated as the Model 38B Weathermaker, has been scheduled by Carrier Corp., Syracuse, N. Y., for 1951. The unit was introduced last year for limited distribution only, and will now be made available on a somewhat wider geographical basis.

Providing ventilation with filtered air, summer cooling and dehumidifying, and automatic gas heating all in one compact package, the unit is operated by a single thermostat, with a single control to switch from summer to winter operation. The cabinet is insulated against heat and sound transmission, permitting installation in a game room or a space adjacent to living quarters.

It is available in three capacity combinations to meet a wide range of heating and cooling requirements. These include 5 hp cooling and A.G.A. rated 190,000 Btu per hour heating, 5 hp cooling and 140,000 Btu per hour heating, and 3 hp cooling and 140,000 Btu per hour heating. Dimensions for all three combinations are 43 inches deep, 52 inches wide, and 70 inches high. Either top or side flue connections are offered to simplify low ceiling or other limited space problems. The return air duct may be brought either to the back or the bottom of the unit.

For more information, circle on Inquiry Card, **Item 27**

Air Pressure Drop Switch

A low pressure, moderately priced pressure-actuated switch, designed to respond to the slightest change in pressure, is being manufactured by F. W. Dwyer Mfg. Co., Chicago, Ill. According to the manufacturer, this switch is extremely accurate for indicating pressure drops in air filters, across coils, to indicate power or blower failure, actuating motors on automatic air equipment, to warn against unsafe or uneconomical operating conditions in forced air feed and boiler draft, and used with pitot static head to indicate air velocities above or below standard or safe values.

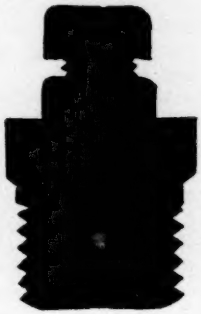
The slack diaphragm of this actuated switch is linked to a beryllium copper spring with a high sensitivity micro-switch which is actuated by pressure from the spring. Pressure changes are reflected in the movement of the spring—and in turn the micro-switch opens or closes the circuit. The switch is capable of operation on plus, minus or differential pressures up to 4 inches of water for standard models.

Switch is made in two models. Model 1620 (illustrated) is 4½ inches in diameter with a minimum setting of 0.25 inch water with a gap between the make and break pressure of 0.20 inch water or greater. Model 1625 is 7 inches in diameter with a minimum gap between the make and break pressures of 0.05 inch water in the lower settings, 10% or more of the setting in the higher ranges.

For more information, circle on Inquiry Card, **Item 28**

Sampling or Venting Valve

A double duty valve, which can be used for sampling oils and other liquids or for venting air into tanks, is announced by Oil-Rite Corp., Milwaukee, Wis., for use on oil-immersed electrical equipment. The valve has many applications on a variety of industrial equipment and processing machinery requiring periodic sampling of liquids or venting air.



When used for sampling, valve is inserted close to the bottom of the oil or other liquid-containing tank, permitting samples to be drawn off conveniently. Inserted at the top of a tank, the same valve can be used for venting air.

The brass valve has a steel ball inside its body which is pressed against the seat of an orifice by a threaded hex bolt. A hex nut on the bolt locks the assembly securely in place. The hex bolt has a hole through the center to permit the passage of liquid to be sampled or air for venting. It also has a cross-slot at its end nearest the ball. The valve has a half-inch male pipe thread for mounting.

When the threaded bolt is backed up, the steel ball is lifted from its seat, permitting liquid to flow past the ball, through the cross-slot and on through the center hole of the bolt where it is collected for sampling.

For more information, circle on Inquiry Card, **Item 29**

Crane Cab Cooling Unit

New type equipment for air conditioning the cabs of cranes operating in high temperatures or in atmospheres contaminated by toxic and noxious gases or dusts, has been developed by Dravo Corporation, Pittsburgh, Pa.

With the new equipment, known as the Split-Type crane cab cooler, no ductwork is needed for installation because the cooling section is installed in the cab itself and the larger condenser section is placed outside on the crane in any convenient location. The unit provides constant, year-round ventilation, filters the air to remove dust, dirt and fumes, cools the air in the summer and, if necessary, heats the air during the winter.

For more information, circle on Inquiry Card, **Item 30**

PRODUCT INFORMATION SERVICE

Use the postage-free postcards below for further information on:

- **News of Equipment and Materials**
- **New Catalogs**

Circle the Item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

AIR CONDITIONING CATALOG

The equipment needed to do a job of air conditioning: cooling, heating, dehumidifying, cleaning, filtering, circulating; or ventilating; or air handling is covered in a 16-page condensed catalog, SA-6692, available from Westinghouse Electric Corp., Sturtevant Div., Hyde Park, Boston, Mass. Covered in the catalog are: hermetically-sealed compressors, condensers, water coolers, heating coils, cooling coils, air-handling units, heating and ventilating units, surface dehumidifiers, air washers, filter washers, central-plant type completely self-contained air conditioning units, unit heaters, industrial heaters, and all types of fans. ....Item 31

DUST AND FUME CONTROL

The first issue of **Industrial Ventilation**, a new periodical devoted to the latest developments in industrial dust and fume control, has been published by American Wheelabrator & Equipment Corp., Mishawaka, Ind. The first issue contains illustrated case histories on the application of Dustube cloth-tube filters to dust control problems in various industries. Of special interest to ventilation engineers is the informative technical discussion on the collecting efficiencies of cloth-type filters. Future editions will present dust and fume control data and information applying to all segments of the chemical and metallurgical industries. .....Item 32

THERMOSTATS AND REGULATORS

Completely illustrated with photographs and cut-away drawings, a 12-page catalog, No. 18, has been issued by H-B Instrument Co., Philadelphia, Pa., covering its mercury-actuated thermo-regulators and thermostats. These devices may be selected according to accuracy requirements from plus or minus 0.005C to plus or minus 0.1C. The equipment described includes advanced design Quick-Set and Red-Top thermo-regulators, and the Multi-Contact thermo-regulators with 3 to 14 operating contacts as well as more simple types. The range extremities are minus 35F to 350F. .....Item 33

PIPE INSULATION MANUAL

To assist architects, engineers and others who have occasion to draw up specifications for insulation jobs, a model specification covering 85% Magnesia insulation of heating systems in commercial and institutional buildings and multiple dwellings has been published by The Magnesia Insulation Manufacturers Association, Washington, D. C. Among the equipments covered are heating supply and return piping, domestic hot water supply and return piping, hot water heaters and storage tanks, boiler steam drums, boiler flues and breechings, boiler stacks within buildings, feedwater heaters, kitchen exhaust ducts, and steam turbines and pumps. .....Item 34

EXHAUST FANS

A 6-page standard size bulletin, Form 5116, has been published by Holcomb & Hoke Mfg. Co., Indianapolis, Ind., and devoted to its Silent Breeze exhaust and attic fans. Catalog also includes information on accessories, such as shutters and grilles. .....Item 35

HOW TO USE UNIT HEATERS

Where and how to install unit heaters of various types and capacities to provide most effective heat distribution is clearly outlined in a handbook, No. 1395, published by C. A. Dunham Co., Chicago, Ill. It contains a general description of propeller fan unit heaters of the horizontal and vertical discharge types and centrifugal fan heaters of the cabinet type. Easy-to-read diagrams show heat spread patterns and various mounting heights for horizontal and vertical discharge heaters. Installation instructions and recommended piping hook-ups are given for heaters used both with steam and hot water systems. .....Item 36

PLEASE SEND US MORE INFORMATION. Circle below item numbers on which you wish further information.

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HEATING AND VENTILATING

148 LAFAYETTE STREET

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STAINLESS TUBE AND PIPE DATA

A complete handbook, Technical Bulletin 1B, The Properties and Methods of Working Seamless and Welded Tubes and Pipe of the B&W Stainless Cralays, is offered by The Babcock & Wilcox Tube Co., Beaver Falls, Pa. Intended for engineers, designers and fabricators, it is designed to serve as a guide in choosing the proper material and as a help in planning the conversion of stainless steel tubing into finished products for industry. The 104-page leather-bound booklet is eight by five inches, a handy size for desk or pocket. .....Item 37

SCHOOL HEATING AND VENTILATING

A four-page folder, Form 15M21051, has been issued by American Foundry and Furnace Co., Bloomington, Ill., devoted to its June-Aire method of heating with ventilation for schools, a warm air type system with blowers. The bulletin has been prepared primarily for school superintendents and members of school boards, as well as architectural and consulting engineers. .....Item 38

WROUGHT IRON PIPE DATA

To assist technicians in their design and specification work, A. M. Byers Co., Pittsburgh, Pa., has published a 4-page bulletin that contains the most frequently required data on wrought iron pipe. Consolidated tables list size and dimensional data for both standard and extra strong pipe. These tables contain complete information on threads per inch, test pressures, circumference, external areas, length per square foot of surface area, length per cubic foot of volume, gallons per linear foot, and weight of water per linear foot. Consolidated, this incorporates the general data needed for heating, flow and weight calculations. Also included is a radiant heating conversion chart and a formula for use in designing snow melting systems. .....Item 39

HEAT TRANSFER SURFACES

Bulletin ID-151, issued by Modine Mfg. Co., Industrial Division, Racine, Wis., illustrates a wide variety of specialized heat transfer surfaces which the company has developed for industrial products and processes. Surfaces shown are applicable to such equipment as solvent recovery, intercooling, regeneration, gas separation and liquefaction, heat economizing and drying. Included are types providing as much as 300 to 350 sq ft of surface per cu ft of volume. .....Item 40

HOW TO USE PERIMETER INSULATION

A 20-page booklet relating The Story of Perimeter Insulation for Standard Heating Systems. Form D51-6, has been published by Owens-Corning Fiberglas Corp., Toledo, Ohio. It contains many diagrammatic sketches illustrating the proper method of installing perimeter insulation. It has been prepared for heating equipment manufacturers, home owners, builders, and others, in view of the demand for basementless houses using concrete slab floors on grade. In step-by-step instructions, including sketches, the sequence is outlined for installation of the perimeter insulation as: When the job is begun, the foundation is poured and the forms removed. The inner face of the foundation wall should not be backfilled; the perimeter insulation is laid against the foundation wall and enough earth should be backfilled to hold the insulation in position, and the backfill should be graded for installation of warm air perimeter ducts or hot water pipes and crushed stone or gravel filled to the required depth over the graded earth. Then installation of the warm air ducts or hot water pipes should be completed in the standard manner and the floor slab then poured. .....Item 41

PIPE COUPLINGS

Couplings Specification Sheet No. 451-C, listing dimensions of line, water well, and other pipe couplings, is offered by Capitol Mfg. & Supply Co., Columbus, Ohio. Compiled for easy reference, the specifications follow the recommendations of American Iron & Steel Institute and other trade organizations. .....Item 42

GATE VALVES AND FLANGES

Bulletin W-350-85C describing gate valves, flanges, and hose nipples, has been issued by Worthington Pump and Machinery Corp., Harrison, N. J. Item 43

WIDE RANGE OIL BURNING SYSTEM

The Peabody constant differential system for use on large oil combustion installations is the subject of a bulletin by Peabody Engineering Corp., New York, N. Y. It covers oil-air ratios and how they affect combustion efficiency under varying loads. .....Item 44

AUTOMATIC CO_2 RECORDER

A new condensed bulletin, 51-553, on its automatic CO_2 recorder is now available from The Hays Corp., Michigan City, Ind. It covers application of the instrument and an easily-understood description of the Orsat principle of operation, complete with a detailed, two cover, schematic drawing. Features such as temperature compensation and self-leveling are explained; installation and sampling are described and illustrated. A handy selector chart is included as a guide to mountings and various models. .....Item 45

Product Information Service

Use the postage-free postcards below for requesting further information on products mentioned in the following sections of this magazine:

News of Equipment and Materials • **New Catalogs**

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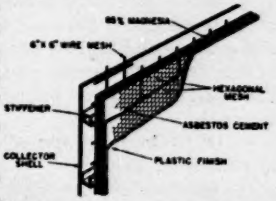
PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Insulation Checks Condensation and Corrosion

PROBLEM: At the downtown steam plant of a Baltimore public utility, corrosion of equipment was accelerated by condensation of moisture from hot gases. Corrosion was particularly noticeable on surfaces of roof dust collectors installed to prevent air pollution by smoke and fly ash from boilers.

SOLUTION: A layer of 1½ inch thick 85% magnesia blocks was applied to the collectors over 6 x 6 inch wire mesh welded to the exposed angle stiffeners. A layer of 1½ inch hexagonal wire mesh was then applied, covered with a ½ inch layer of asbestos cement. Because of outside installation, the insulation was given a weather resistant finish by stretching a layer of 1 inch hexagonal wire mesh over the asbestos cement and then applying weather resistant asphaltic asbestos plastic.

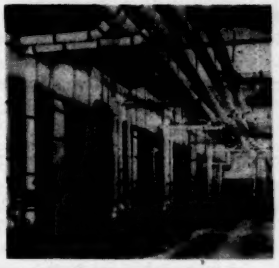


RESULTS: Temperature of the metal collector shells is kept between 280-300F, preventing condensation of flue gases and the resulting corrosion. Maintenance requirements are reduced and the life of the collectors increased.

14 Units Zone Large Plant

PROBLEM: In the new $3,000,000 plant of Union Hardware and Metal Company, largest firm of its kind west of the Mississippi, the architectural firm of Albert C. Martin & Associates specified 14 zones for the air conditioning system.

SOLUTION: Fourteen Recold air conditioning units, product of the Refrigerating Engineering Inc., were installed in a special equipment room located on the top of the office building. Arranged in two rows of seven units each, one row handles the entire lower floor of the merchandising building, while the other handles the second floor. Each unit handles one zone, and the heat flow of each zone is so balanced that 13 units are of identical capacity. One smaller unit is required for a smaller zone. The units used are Model UVT140 and one smaller unit, Model UVT66. The larger units deliver between 6,000 and 8,000 cfm each, while the smaller one delivers 3,500 cfm. Air is handled by two large axial flow fans. The job is used at present for heating but is so designed that cold water coils may be added in blanked-off spaces provided for that purpose.

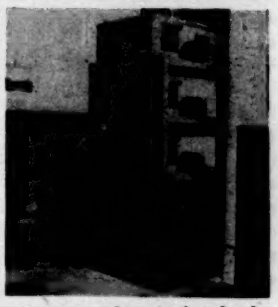


RESULTS: Complete control of temperature in each zone is assured and future installation of summer air conditioning made relatively easy.

Window Units Solve Hongkong Problem

PROBLEM: In a Hongkong building housing the A. S. Watson & Company, Ltd. offices, availability of only low voltage electrical circuits prohibited the use of large capacity air conditioning equipment without expensive rewiring. Moreover, the water supply was not adequate to satisfy requirements of a larger system. There was no space available for a remotely located installation, and the A. S. Watson Company did not want to sacrifice office space for air conditioning equipment. A survey showed that about 8 tons of capacity were required.

SOLUTION: With remote equipment out of the question, Dodwell & Company, Ltd., Hongkong Frigidaire distributor, turned to Frigidaire window type room air conditioners. It was found that 8 of the 1 hp units would do the air conditioning job successfully. However, there were only two windows in which to install the room units. Since the company was in need of more space for storing books and ledgers, C. L. Salter, Frigidaire representative, decided to kill two birds with one stone. He built two bookcases for the office, one at each end of the large main office room. On the top of each bookcase he constructed a sturdy shelf arrangement and mounted three Frigidaire room air conditioners, one over the other. The extra book storage compartment more than made up for the loss of floor space. Inlet and exhaust ducts, equipped with powerful fans, were connected to the outside by running them at ceiling height through an enclosed veranda adjacent to the main office. The units operate through special voltage adjusting transformers.



RESULTS: During normal summer weather, one of the two complete refrigerating systems contained in each unit is adequate to handle the air conditioning load. On especially hot humid days, the second system provides extra capacity. No water or drain connections are required and the units operate when plugged into the nearest electrical outlet.

Kooler-Aire Serves Largest Diner

PROBLEM: The largest single section diner ever delivered into the metropolitan New York area, a 70-foot fully air conditioned unit known as the Yankee Clipper, was set up and equipped with air conditioning in Valley Stream, L. I., following a dramatic shipping operation which carried it in one piece from the manufacturing plant in Elizabeth, N. J., over two bridges and through New York City to its present site. While interior ductwork had been installed during construction of the diner, the air conditioning equipment had to be installed on the site.

SOLUTION: Assembly of the air conditioning system on the site was simplified by utilization of a 15-ton packaged Kooler-Aire unit manufactured by the U. S. Air Conditioning Corp. The unit was placed in the basement, and supply ducts were run through the kitchen and along the outside of the diner. Ductwork was placed along the rear of the diner roof so that it would not be visible from the street side. Air distribution is through square diffusers which blend into the mirrored portion of the ceiling. For winter heating, a warm air heating unit provides heated air to the blower section of the unit which circulates it through the same ductwork.

RESULTS: Knud C. Thommesen, owner of the Yankee Clipper, who has been in the diner business for over 20 years, considers air conditioning an absolute must for diners. He says that aside from comfort consideration, air conditioning keeps the diner free of smoke and its windows free from condensation. Packaged equipment is ideal for installation in factory built diners, according to the owner. Construction was completed at the site by merely setting the unit in place and making a few simple connections.

Heaters Speed Cold Weather Construction

PROBLEM: The Ford Motor Company's construction department planned to continue work inside a large new Cleveland plant during cold winter weather.

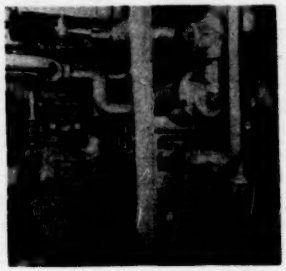
SOLUTION: Six temporary oil-fired Dravo Counterflo heaters, standard industrial direct-fired units, were mounted on timber skids so they could be positioned where needed in the construction area. Two 250-gallon fuel oil tanks were supported on steel angles built on skids. With this arrangement, the heaters needed only a 220-volt power line for operation. Metal vent stacks were attached to the heaters to discharge into the atmosphere near roof level in the partially completed building where fumes were quickly dissipated. Wherever possible, openings were left in the metal deck roof for exhaust gases to vent outside.

RESULTS: Besides maintaining comfortable temperatures for workmen in the buildings, the six heaters kept the ground inside from freezing and permitted concrete pouring during freezing weather. The heat also helped cure the concrete.

Texas-Size Heat Pump Serves Utilities Building

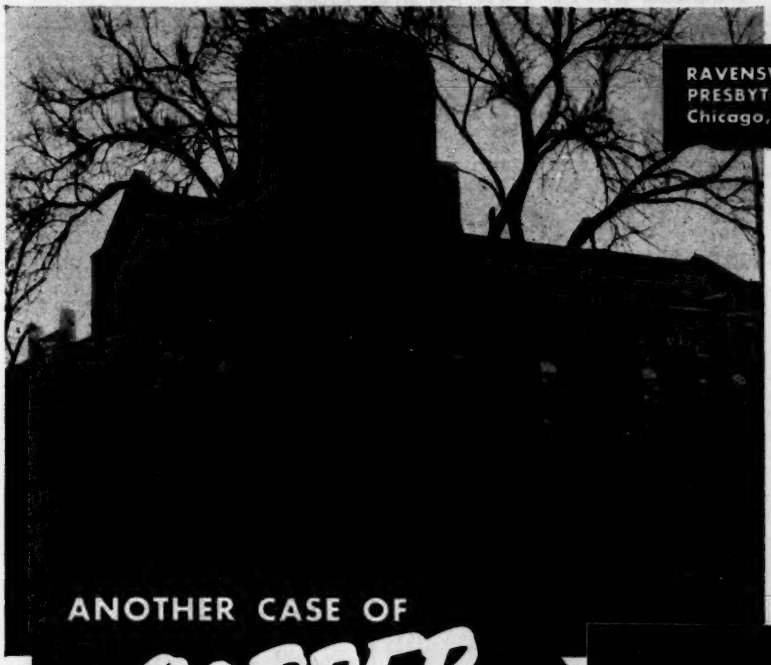
PROBLEM: Gulf States Utilities Company of Beaumont, Texas, supplies approximately 2 billion kilowatt-hours of electricity per hour to surrounding territory. Natural gas and fuel oil are very reasonable in price in this area. The company decided to obtain efficiency and operating data on the heat pump for competitive reasons.

SOLUTION: In their new office building, constructed in Beaumont, the company specified a heat pump for winter heating and summer cooling. Two systems are specified, each consisting of a Freon-12 compressor and auxiliaries comprising the York system. Well water is used in the condensers during cooling operation. This same water is used in winter as a heat source. Automatic control is provided for both summer cooling and winter heating, water leaving the cooler in summer operation is maintained at an average temperature of 43F. For winter heating, a water temperature of 107F from the condenser is maintained. The changeover from summer to winter cycles is automatic.



RESULTS: The York system was installed during 1950 cooling season and functioned efficiently. Engineers of the Gulf States Utilities Co. are keeping accurate costs on the operating expenses for both cooling and heating, and will be able to report comprehensively on the system. They are confident that more of the systems will be installed soon after these data are available. The complete installation was made by the Reed Company, York distributor in Beaumont.

HEATING AND VENTILATING will pay for acceptable Product Application stories of new, unusual, or ingenious uses of equipment or materials sent to this magazine exclusively. Items should be about the length of those in this month's issue and should be illustrated if possible. Payment is on publication. Send to Editor, Heating and Ventilating, 148 Lafayette Street, New York 13, N. Y.

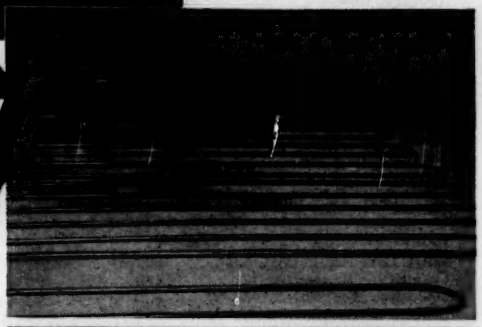


RAVENSWOOD
PRESBYTERIAN CHURCH
Chicago, Ill.

(Below-Top) Section of radiant panel heating system before concrete was poured. 16,500 ft. of ¾"; 2,000 ft. of 1¼" and 1,500 ft. of 1½" Revere Copper Water Tube were used. Architect and Engineer, Benj. Franklin Olson; General Contractor, Harry C. Bjorklund & Son; Revere Distributor, The Davies Supply Co., all of Chicago. Harden Heating & Air Conditioning Co., of Elmwood Park, Ill., was Heating Contractor.

(Below-Bottom) Shows arrangement of balancing cocks on a return header. System was designed for zone control, a most important requirement for efficient operation in this type of edifice.

ANOTHER CASE OF *COPPER where it counts!*



CHURCHES, schools, colleges, municipal, office and similar buildings must be built to last. It's the only way to make them pay. That's why you'll find enduring materials like copper, brass and bronze used in so many places in so many of them.

The lasting quality of Revere Copper Water Tube was one of the reasons for its being used for the radiant panel heating system in the Ravenswood Church. Revere Copper Water Tube is non-rusting. It costs no more for workmen to install because its 60′ lengths are easy to bend and handle . . . it requires fewer fittings than rustable, short-lived materials. What joints are necessary are permanently soldered in a jiffy. That's why more and more architects, engineers, builders and contractors have been using it where it counts.

Although copper tube cannot now be used in civilian installations of radiant panel heating, we cite the Ravenswood Presbyterian Church to remind you of the merits of Revere Copper Water Tube over other materials so that when copper is once more permitted you will again use it. Meantime remember, you can still use Revere Copper Tube in underground service lines, domestic hot and cold water supply lines, industrial processing and for gas equipment.

Revere Copper Water Tube is available in hard and soft tempers in straight lengths; also in 60′ coils in soft temper. Each length is marked with the Revere name. Look for this mark. It assures you of uniform quality. These materials are available through your Revere Distributor, who will also put you in touch with Revere's Technical Advisory Service in the event you wish to discuss your technical problems.

REVERE 150

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DEGREE-DAYS FOR APRIL, 1951

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 23rd Year of Publication of Monthly Degree-Day Data

City	April			Cumulative, September 1 to April 30			Heating Season[1]
	1951	1950	Normal	1950-51	1949-50	Normal	Normal
Abilene, Texas (A)	134	128	27	2484	2189	2061	2061
Albany, New York (A)	514	654	549	6211	6593	6397	6580
Albuquerque, New Mexico (A)	301	195	288	3685	3802	4258	4298
Alpena, Michigan (C)	720	923	789	7268	7411	7662	8299*
Anaconda, Montana (C)	783	821	756	7616	7725	7493	8357**
Asheville, North Carolina (C)	332	368	330	4116	3543	4161	4232
Atlanta, Georgia (C)	190	217	132	2968	2446	2890	2890
Atlantic City, New Jersey (C)	404	525	519	4277	4181	4956	5176
Augusta, Georgia (A)	133	152	121	2625	1850	2161	2161
Baker, Oregon (C)	544	680	615	6059	6607	6519	7163
Baltimore, Maryland (C)	295	396	348	4060	3819	4511	4533
Billings, Montana (A)	685	665	534	7129	7219	6743	7119
Binghamton, New York (C)	507	663	594	5938	6052	6554	6808
Birmingham, Alabama (A)	186	211	69	2867	2239	2352	2352
Bismarck, North Dakota (A)	738	932	657	9508	9623	8809	9192
Block Island, Rhode Island (A)	505	632	633	4775	4885	5311	5788
Boise, Idaho (A)	422	517	435	5121	5671	5316	5552
Boston, Massachusetts (A)	416	539	570	4854	5266	5800	6045
Bozeman, Montana (C)	722	730	731	7882	7466	7724	8521**
Buffalo, New York (A)	592	744	675	6102	6193	6475	6822
Burlington, Iowa (A)	529	606	(a)	6503	5969	(a)	(a)
Burlington, Vermont (A)	599	736	654	6818	7259	7238	7514
Butte, Montana (C)	810	825	741	8020	7979	7424	8235**
Cairo, Illinois (C)	311	277	201	4080	3465	3909	3909
Canton, New York (C)	(a)	747	684	(a)	7462	7686	8020
Charleston, South Carolina (C)	58	128	36	2031	1394	1769	1769
Charlotte, North Carolina (C)	168	230	159	3110	2687	3120	3120
Chattanooga, Tennesee (A)	236	250	144	3377	2872	3118	3118
Cheyenne, Wyoming (A)	822	734	720	6712	6538	6894	7466
Chicago, Illinois (C)	553	670	518	6004	5649	5764	6077
Cincinnati, Ohio (C)	381	434	333	4691	4094	4684	4684
Cleveland, Ohio (A)	540	655	564	5806	5580	5935	6155
Columbia, Missouri (A)	458	454	303	5193	4637	4900	4922
Columbia, South Carolina (C)	124	168	63	2534	2054	2364	2364
Columbus, Ohio (C)	464	555	420	5333	4867	5311	5398
Concord, New Hampshire (A)	574	693	669	6384	7004	7001	7353
Concordia, Kansas (C)	485	484	342	5397	5236	5250	5315
Dallas, Texas (A)	115	132	9	2293	2076	2256	2256
Davenport, Iowa (C)	535	626	453	6472	6009	6171	6289
Dayton, Ohio (A)	515	594	396	5839	5276	5183	5264
Deer Lodge, Montana (C)	738	736	735	7702	7682	7860	8672**
Denver, Colorado (C)	628	515	534	5590	4897	5607	5874
Des Moines, Iowa (A)	587	616	441	6775	6413	6266	6384
Detroit, Michigan (A)	562	696	573	6083	6060	6264	6490
Devils Lake, North Dakota (C)	797	1007	756	10093	10396	9450	9970
Dodge City, Kansas (A)	459	423	342	4980	4716	4988	5035
Dubuque, Iowa (C)	639	694	489	7184	6636	6641	6790
Duluth, Minnesota (C)	798	1009	1265	9148	9138	8746	9483
Eastport, Maine (C)	639	768	786	6346	6914	7398	8520**
Elkins, West Virginia (A)	504	586	501	5611	5192	5520	5697
El Paso, Texas (A)	131	42	45	2346	2136	2428	2428
Ely, Nevada (A)	841	672	(a)	6436	6761	(a)	(a)
Erie, Pennsylvania (C)	558	700	609	5645	5545	6016	6273
Escanaba, Michigan (C)	759	981	828	7899	8053	8118	8771
Evansville, Indiana (A)	401	425	276	4895	4184	4244	4244
Fort Smith, Arkansas (A)	240	207	93	3457	3096	3147	3147
Fort Wayne, Indiana (A)	550	669	474	6245	5905	5795	5925
Fort Worth, Texas (A)	112	123	27	2323	2109	2148	2148
Fresno, California (A)	146	104	135	2198	2538	2334	2334
Galveston, Texas (C)	35	30	0	1115	653	1016	1016
Grand Junction, Colorado (A)	391	365	384	5110	5423	5430	5548
Grand Rapids, Michigan (A)	609	756	534	6510	6204	6361	6535
Green Bay, Wisconsin (C)	691	881	600	8123	7936	7503	7825
Greensboro, North Carolina (A)	270	300	210	3891	3441	3529	3529
Greenville, South Carolina (A)	205	237	195	3244	2842	3380	3380
Harrisburg, Pennsylvania (A)	400	513	405	5100	4974	5285	5375
Hartford, Connecticut (A)	441	575	531	5323	5717	5834	6036
Hatteras, North Carolina (C)	145	238	255	2514	1869	2571	2571
Havre, Montana (C)	701	712	630	8459	8884	8187	8700
Helena, Montana (A)	723	726	646	7927	7983	7261	7894**
Houston, Texas (C)	42	38	0	1209	852	1157	1157
Huron, South Dakota (A)	681	806	570	8091	8215	7737	8004
Indianapolis, Indiana (A)	512	575	384	5822	5184	5239	5298
Jackson, Mississippi (A)	142	155	(a)	2297	1729	(a)	(a)
Kansas City, Missouri (A)	439	433	306	5064	4695	4950	4956
Knoxville, Tennessee (A)	277	298	210	3696	3125	3670	3670
La Crosse, Wisconsin (A)	658	777	528	7966	7800	7139	7322
Lander, Wyoming (A)	722	690	690	7028	7134	7384	7947

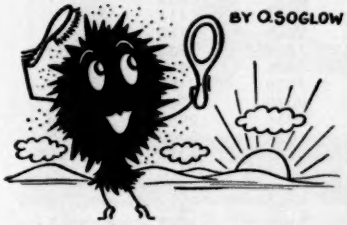
(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, inclusive.

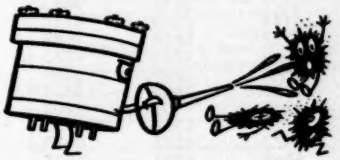
Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 116]

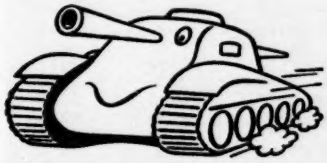
AIR-MAZING FACTS



DUST CAN BE BEAUTIFUL! Airborne dust—often a nuisance to industry—is also the cause of one of the most spectacular beauties of nature! Fine dust particles in the atmosphere reflect some colors of the sunlight more strongly than others—give us our colorful sunsets.



STOPS DUST WITH OIL! Air-Maze oil bath filters literally "scrub" intake air in a pool of oil. Used on large diesel engines and air compressors, they keep damaging dust and dirt from moving parts.



KEEPS SHIFTLESS TANKS ON THE GO. Automatic transmissions in the newest Army tanks use Air-Maze oil filters to remove trouble-causing abrasive dirt from the oil. Air-Maze liquid filters provide many times more net effective filter area than other permanent types.

WHETHER YOU BUILD OR USE engines, compressors, air-conditioning or ventilating equipment, or *any device using air or liquids*—the chances are there is an Air-Maze filter *engineered* to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

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The Filter Engineers

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Here's the greatest TIME-SAVING MONEY-SAVING fastening team in history!

for Split-second Fastening of steel or wood to concrete, steel, masonry

With the introduction of the new heavy-duty "400", DRIVE-IT now offers the best engineered fastening team in the history of powder-powered tools.

Time-tested, exclusive features of the popular DRIVE-IT "300" have now been embodied in the new heavy-duty "400". These include CONTROLLED POWER with one power load, PERMANENT, ADJUSTABLE safety pad, SURFACE PROTECTOR to prevent splitting wood and 25% greater driving power.

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(Canadian Distributor:) Ammo Power Tool Co., Ltd.
Foot of McLean Drive, Vancouver, B. C.

Degree-Days for April, 1951 (Concluded)

(A) Airport readings; (O) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 23rd Year of Publication of Monthly Degree-Day Data

City	April			Cumulative, September 1 to April 30			Heating Season[1]
	1951	1950	Normal	1950-51	1949-50	Normal	Normal
Lansing, Michigan (A)	612	749	582	6655	6611	6819	7048
Lewiston, Maine (O)	550	674	693	6382	6924	7318	7707
Lincoln, Nebraska (C)	548	542	417	6035	5859	5900	5999
Little Rock, Arkansas (A)	216	168	78	3168	2693	2811	2811
Livingston, Montana (C)	692	677	653	6871	6741	6638	7245**
Los Angeles, California (C)	134	89	159	1055	1372	1414	1504
Louisville, Kentucky (A)	389	388	264	4709	3961	4180	4180
Lynchburg, Virginia (A)	305	344	273	4220	3763	3980	3980
Macon, Georgia (A)	103	153	33	2317	1786	2201	2201
Madison, Wisconsin (C)	617	756	582	7369	7058	7193	7429
Marquette, Michigan (C)	782	972	804	7838	8020	7968	8693*
Memphis, Tennessee (A)	245	235	96	3351	2834	2950	2950
Meridian, Mississippi (A)	152	173	24	2438	1877	2160	2160
Milwaukee, Wisconsin (A)	660	767	648	7130	6742	6856	7245
Minneapolis, Minnesota (A)	675	834	570	8274	8061	7614	7850
Montgomery, Alabama (A)	121	141	0	2291	1544	1884	1884
Nantucket, Massachusetts (A)	532	680	639	4916	5188	5450	5957
Nashville, Tennessee (A)	325	312	180	3927	3302	3507	3507
New Haven, Connecticut (A)	451	604	543	5132	5387	5672	5895
New Orleans, Louisiana (C)	49	55	0	1226	775	1024	1024
New York, N. Y. (C)	378	494	465	4470	4439	5073	5274***
Nome, Alaska† (A)	1994	1528	1756	13644	9664	10642	14580**
Norfolk, Virginia (C)	206	283	246	3099	2674	3350	3350
North Head, Washington (C)	487	533	516	4220	4469	4271	5452**
North Platte, Nebraska (A)	623	654	486	6231	6345	6167	6366
Oakland, California (A)	312	266	273	2205	2782	2665	3143**
Oklahoma City, Oklahoma (C)	255	208	162	3535	3277	3613	3613
Omaha, Nebraska (A)	573	559	414	6423	6146	6340	6131
Oswego, New York (C)	600	726	675	6167	6307	6668	7088
Parkersburg, W. Virginia (C)	404	440	351	4791	4349	4722	4775
Peoria, Illinois (A)	528	613	453	6288	5816	5988	6109
Philadelphia, Pennsylvania (C)	328	463	378	4281	4200	4605	4737***
Phoenix, Arizona (C)	35	9	0	1004	1119	1405	1405
Pittsburgh, Pennslyvania (C)	441	524	423	5139	4720	5157	5235
Pocatello, Idaho (A)	535	626	567	6078	6477	6263	6655
Portland, Maine (A)	574	718	666	6407	6988	6771	7218
Portland, Oregon (C)	259	425	402	3712	4292	4134	4469
Providence, Rhode Island (C)	386	539	558	4742	5192	5764	6015
Pueblo, Colorado (A)	525	418	456	5283	4824	5328	5514
Raleigh, North Carolina (C)	179	272	183	3173	2719	3234	3234
Rapid City, South Dakota (A)	725	801	594	7053	7382	6744	7118
Reading, Pennsylvania (C)	362	487	417	4726	4688	5293	5389
Red Bluff, California (A)	131	137	(a)	2425	2740	(a)	(a)
Reno, Nevada (A)	452	503	534	4990	5452	5436	5892
Richmond, Virginia (C)	258	310	246	3692	3247	3695	3695
Rochester, New York (A)	573	716	676	6184	6346	6832	6732
Roseburg, Oregon (C)	(a)	(a)	411	(a)	(a)	4047	4428
Roswell, New Mexico (A)	226	173	180	3297	3103	3484	3484
Sacramento, California (C)	191	127	207	2225	2508	2600	2653
St. Joseph, Missouri (A)	485	490	342	5594	5310	5145	5161
St. Louis, Missouri (C)	410	423	276	4916	4217	4585	4585
Salt Lake City, Utah (A)	435	488	453	5752	5497	5319	5555
San Antonio, Texas (A)	51	48	0	1562	1152	1202	1202
San Diego, California (A)	123	127	174	1143	1441	1524	1645
Sandusky, Ohio (C)	545	626	726	5680	5316	6025	6208
San Francisco, California (C)	373	267	294	2191	2474	2417	3264**
Sault Ste. Marie, Michigan (A)	732	1054	819	8173	8676	8448	9285**
Savannah, Georgia (A)	76	138	0	2041	1333	1490	1490
Scranton, Pennsylvania (C)	460	598	513	5519	5606	5958	6129
Seattle, Washington (C)	337	452	462	3933	4464	4379	4934**
Sheridan, Wyoming (A)	726	716	648	7133	7491	7485	8008
Shreveport, Louisiana (A)	126	128	0	2254	1807	1938	1938
Sioux City, Iowa (A)	630	662	489	7098	7045	6734	6898
Spokane, Washington (A)	496	629	504	6047	6912	5989	6355
Springfield, Illinois (C)	464	505	366	5596	4951	5317	5373
Springfield, Missouri (A)	429	393	267	4757	4372	4416	4428
Syracuse, New York (A)	547	668	630	6266	6325	6614	6893
Tacoma, Washington (C)	408	509	465	4286	4751	4551	5181**
Terre Haute, Indiana (A)	491	551	333	5700	5024	4872	4872
Toledo, Ohio (A)	563	675	525	6177	5920	5897	6077
Topeka, Kansas (C)	452	427	300	5071	4818	4935	4969
Trenton, New Jersey (C)	380	502	402	4668	4657	4852	4933
Utica, New York (O)	578	697	588	6094	6589	6543	6796
Valentine, Nebraska (C)	691	788	561	6982	7197	6766	7039
Walla Walla, Washington (C)	311	430	363	4421	5214	4637	4808
Washington, D. C. (C)	281	377	348	4009	3730	4601	4626
Wichita, Kansas (A)	408	392	252	4683	4435	4673	4673
Williston, North Dakota (C)	765	891	669	9444	9676	8907	9323
Winnemucca, Nevada (C)	471	572	539	5368	5931	5950	6427**
Yakima, Washington (A)	423	544	360	4178	6198	5413	5599

(a) Data not available.
†Nome data are for March

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, inclusive.

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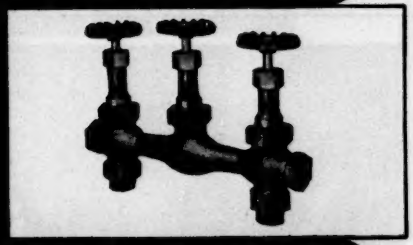

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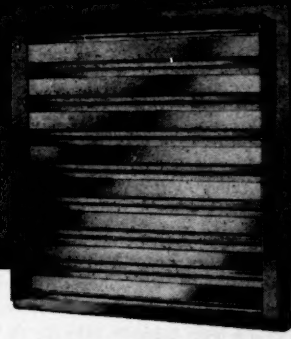

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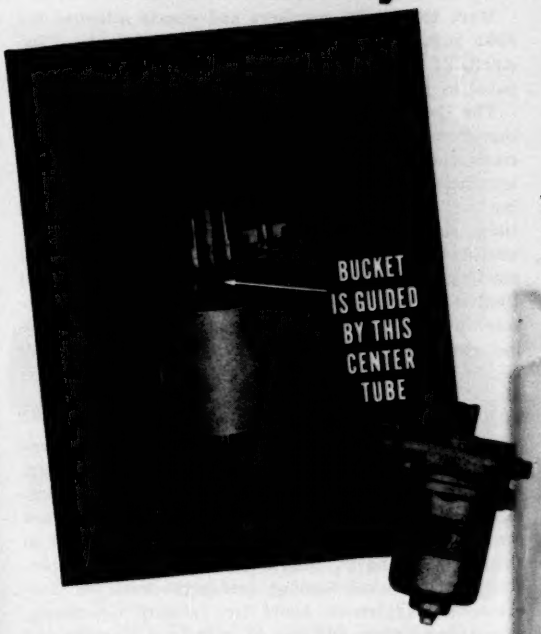

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NEWS OF THE MONTH

INDUSTRIAL HEALTH CONFERENCE

examines medical and engineering methods of preserving health of workers.

More than 2,000 members and guests attended the 1951 Industrial Health Conference at Atlantic City, April, 21 to 28. Five national organizations participated in joint and concurrent sessions.

The Conference represented the 36th annual meeting of the American Association of Industrial Physicians and Surgeons, 12th annual meeting of the American Industrial Hygiene Association, 13th annual meeting of the American Conference of Governmental Industrial Hygienists, 9th annual meeting of the American Association of Industrial Nurses, Inc., 8th annual meeting of the American Association of Industrial Dentists. Two organizations under government sponsorship met to discuss their particular problems in industrial health. These were the U. S. Naval Industrial Health Organization and Conference of Industrial Health Personnel of the U. S. Atomic Energy Commission.

Eleven scientific and 75 technical and commercial exhibits were set up for inspection during the conference.

• **ACGIH.**—Technical seminars were scheduled for Sunday, April 22 by the governmental hygienists. Four concurrent seminars discussed problems of interest to chemists, engineers, nurses and physicians, respectively. At technical sessions during the week the Governmental Hygienists heard Dr. Leonard Greenberg, executive director, Division of Industrial Hygiene and Safety Standards, New York State Department of Labor, offer a preview of new construction from the standpoint of controlling health and safety hazards. Other subjects covered at governmental sessions included a description of industrial state employee health services, voluntary health insurance for industry, and air pollution. Reports from national, state and local governmental organizations were presented at a symposium on industrial hygiene mobilization for civilian defense.

• **COAL DUST.**—At a joint meeting with the American Industrial Hygiene Association, governmental hygienists heard Dr. F. J. Vintinnar describe animal experiments investigating the effects of coal dust and smoke on the lungs, with special reference to susceptibility to pneumonia. Dr. Vintinnar pointed out that rats exposed for 8 hours a day to high concentrations of bituminous coal dust or bituminous coal smoke over periods ranging from 6 to 166 days do not reveal any increase in susceptibility to lobar pneumonia, nor was there any evidence of pathological damage to the lung tissue.

The public health hazard of organic insecticides was discussed by J. C. Ward of the U. S. Department of Agriculture. The epidemiology of beryllium anti-toxin was covered in two talks; environmental aspects by M. Eisenbud of the U. S. Atomic Energy Commission, and medical aspects by Dr. J. H. Sterner, medical director, Eastman Kodak.

AIHA officers: (l to r) Allen D. Brandt, past president; Anna M. Baetjer, president; W. R. Bradley, president-elect.

• **AIHA.**—Maintaining clean air in the industrial environment was the main topic of the Tuesday afternoon session of the American Industrial Hygiene Association. Following an address of welcome by President Allan D. Brandt, Bethlehem Steel Company, an engineering and chemistry session was held under the chairmanship of J. C. Radcliffe, Ford Motor Co., and W. F. Reindollar, Maryland State Department of Health.

• **RECIRCULATION.**—Robert H. Avery, American Air Filter Company, described installations involving recirculation of cleaned air from cast iron machines. Pointing out that 98% by weight of all material generated in cast iron grinding processes is a mass of fine granular chips varying in size from ¼ inch down to a few microns. Mr. Avery said that the remaining 2% is finely divided graphitic carbon dust. By the use of local exhaust ventilation on cast iron machining operations, it is possible to prevent the graphitic dust from escaping into the working atmosphere. Since the dust becomes air-borne with high initial velocity, it is not necessary to have a high capture velocity at the point of generation.

• **HOODS.**—Design of exhaust hoods for hot processes was discussed by W. C. L. Hemeon, Industrial Hygiene Foundation. Mr. Hemeon described how a canopy hood over either a horizontal hot surface or a steaming tank differed from canopy hoods over cold processes in that a substantial volume of air tends to be set in motion by convection from the processes and must be exhausted by adequate capacity if it is to be prevented from spilling out around the edges of the canopy. Mr. Hemeon offered a mathematical means of determining the capacity required in hooding hot processes.

• **MISTS.**—Control of dusts by water mists was the

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DUX-SULATION
is BEST FOR DUCT INSULATION

1 High thermal and acoustical insulating properties... K factor of .27 BTU and sound absorption approximately 61%. Integral, woven asbestos membrane.

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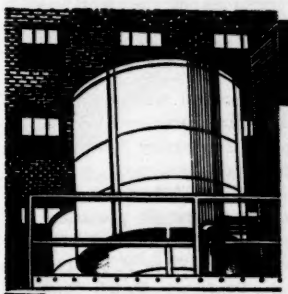

INDUSTRIAL SOUND CONTROL

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COOLING
TOWERS
In Air Conditioning Installations

PUT AN END TO
ANNOYANCE • COMPLAINT
THREATS OF LEGAL ACTION
DUE TO DISTURBING NOISE

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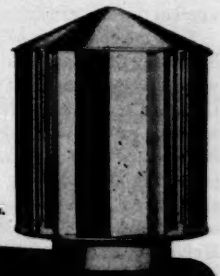
Ask for PROOF
OF PERFORMANCE!

Claims are a dime a dozen in the ventilating field. The only way to be *sure* of what you're buying in *any* make of ventilator is to insist on certified capacity ratings derived from tests made with the wind blowing against the ventilator in *all* directions as shown below. True performance under actual operating conditions can be determined only by such tests!



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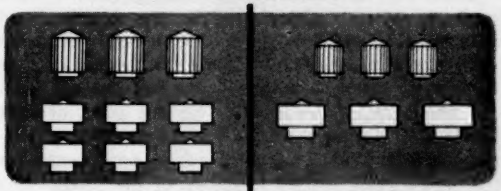

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Get *all* the facts! Write today for complete Engineering Data Book, including certified capacity ratings. Address Dept. B.

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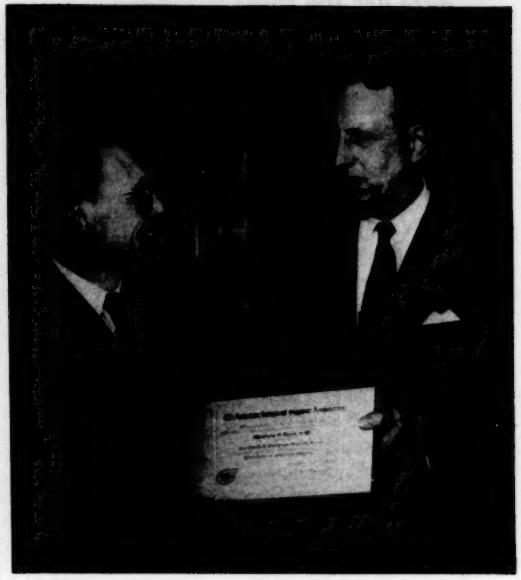
subject of a paper by Kenneth W. Nelson, American Smelting and Refining Company. Mr. Nelson showed that where actual wetting of a dust-producing substance in processes was undesirable or impossible, as in ore crushing, a water mist of fine particle size may be successful in allaying dust without interfering with the process. It was found in an experimental setup that particle size of the mist was more important than the addition of wetting agents. Nozzles for the production of mist using 10.8 gallons of water per hour at 40 lb per square inch with compressed air at 50 lb per square inch were successful in field installations applied to ore crushing.

Two microscopic methods of determining free silica by means of dispersion staining and phase microscopy were described by D. C. Crossmon, Bausch and Lomb Optical Co. W. B. Harris, U. S. Atomic Energy Commission, presented a paper prepared jointly with A. G. Breslin and P. B. Klevin covering the efficiency of filter paper for air sampling at microgram levels. Performance of commercial dust and fume collectors was described in a paper by Richard Dennis, G. A. Johnson, Melvin W. First, and Leslie Silverman, Harvard School of Public Health.

• **SAMPLER.**—K. E. Lauterbauch described a new oscillating thermal precipitator in a paper prepared jointly with S. Laskin and R. H. Wilson of the University of Rochester. The precipitator employs the principle that a hot wire repells any dust particles which come within its immediate vicinity so that air adjacent to the wire is freed of particulate matter. By placing the hot wire between two collector plates and forcing air between the plates, matter is divided around the wire and precipitated on the plates. A controlled oscillation of the plates permits precipitation of particles from a given air sample over measurable area on the collector plates and results in a particle size distribution more in keeping with conditions of the sample than would be the case with a stationary arrangement. Plates can be removed from the precipitator and examined microscopically.

Elaborate high efficiency hooding of machine tools used on materials of high toxicity was described and illustrated by Edwin C. Hyatt in a paper prepared jointly with H. F. Schulte and F. S. Smith, Jr., Los Alamos Scientific Laboratory. General use of lucite for flexibility, double hooding on the point of dust generation, and cooperative attention to the suggestions of employees required to use the equipment were the contributing factors in design of the hoods.

• **VACUUM CLEANER.**—The effect of central vacuum cleaning on air-borne dust concentrations was described by Knowlton J. Caplan in a paper prepared jointly with Donald L. Huelster, Mallinckrodt Chemical Works. Test studies were made in a plant handling dry chemical powders by semi-mechanized methods, both before and after a simple vacuum cleaning system was installed. The installation of the vacuum cleaning system was the only change in operation between the two studies. The effect of the vacuum cleaning system was to reduce air-borne dust concentrations during floor cleaning and equipment cleaning by factor of from 2.2 to 53.8, depending upon the area concerned. Average reduction of dust exposure of operators was 23%.



President Brandt (right) presents Cummings Award to T. F. Hatch.

Round-table conferences on Tuesday evening included separate sessions on atmosphere pollution, chemistry, engineering, radiation, and toxicology.

Wednesday morning sessions of the AIHA were devoted to a series of eight papers on toxicology. Presiding at the sessions were Donald D. Irish, Dow Chemical Co., and Charles R. Williams, Liberty Mutual Insurance Co. Wednesday afternoon was devoted to a joint meeting of all organizations, with Anna M. Baetjer, The Johns Hopkins University School of Hygiene and Public Health, presiding.

• **BANQUET.**—At the annual AIHA banquet Wednesday evening, President Allan D. Brandt presented the Cummings Award for outstanding contribution to the field of industrial hygiene to Theodore F. Hatch, The University of Pittsburgh. Professor Hatch then delivered the Cummings memorial lecture covering the dynamic and increasingly important role of industrial hygiene in all phases of production and the working environment.

Preceding the annual business meeting, a panel discussion on essentials of an industrial hygiene program, with Frank A. Patty, General Motors Research Laboratory, presiding, included the points of view of the national agency by Dr. Leonard Greenberg, the insurance company by E. J. Meiter, the smaller industry by Robert P. Gleason, and the larger industry by Clyde M. Berry.

• **OFFICERS.**—At the business meeting, announcement was made of the election of Anna M. Baetjer as president; W. R. Bradley, American Cyanamid Co., president-elect; F. S. Mallette, American Steel and Wire Co., secretary; C. H. Mahaffey, Mine Safety Appliance Co., treasurer. New directors elected were J. Hammond, J. Radcliffe, and J. Treon.

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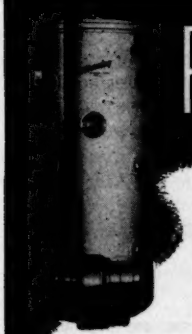

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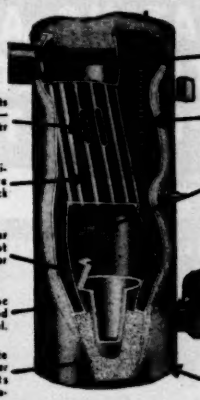

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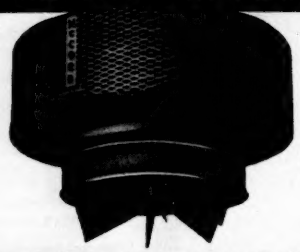

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President Brandt announced the AIHA will sponsor a half-day session at the Philadelphia meeting of the American Society for the Advancement of Science between Christmas and New Year this year, and a half-day session at the National Safety Congress in Chicago on the morning of October 11, 1951. The next annual meeting of AIHA will be at the Netherlands Plaza in Cincinnati, April 19 to 26, 1952.

TECHNICAL PROGRAM

and special events in scenic setting offered in ASHVE semi-annual meeting in Portland, Ore., July 2-4.

The 1951 Semi-Annual Meeting of The American Society of Heating and Ventilating Engineers in Portland, Ore., July 2-4, will present an opportunity to combine a distinctive technical program, which is expected to attract engineers not only from the West Coast but from all sections of the country, and carefully planned special events.

The Oregon Chapter of ASHVE is host for the meeting at the Hotel Multnomah. Bert W. Farnes is general chairman of the committee on arrangements.

• **TECHNICAL.**—The technical program will consist of 12 papers on three main subjects: panel heating and cooling, warm air heating, and the heat pump, which will be presented at three morning technical sessions so as to leave ample time for the special events and for relaxation with friends from all parts of the country.

The opening session will be called to order on Monday morning, by Lauren E. Seeley, president of ASHVE. A luncheon for both the men and ladies on Tuesday, July 3, will be highlighted by an address by Dean G. W. Gleeson of the School of Engineering and Industrial Arts of Oregon State College. Dean Gleeson's subject will be "Energy—Choose it Wisely Today for Safety Tomorrow."

Among the papers to be presented will be one incorporating the results of studies made at the ASHVE Laboratory in Cleveland on four conventional types of ceiling plaster panels, using both non-ferrous tube and ferrous pipe, located both above and below the lath.

The paper will show that the difference between the average tube temperature and the average panel surface temperature can be related to the heat output from the panel by a simple empirical equation. Panel heat outputs are given for various spacings of tubes. The authors are C. M. Humphreys, senior engineer; C. V. Franks, research fellow; and L. F. Schutrum, assistant research engineer.

In another paper, three Oregon engineers will describe the application of a water-to-water heat pump and complete air conditioning to a newspaper plant and office building. Among the innovations to be reported are the use of well water for preheating and precooling; the recovery of heat from exhaust air; and a completely automatic system of control, even to the point of starting and stopping centrifugal refriger-

ation equipment; the heat pumps. The authors of the paper are J. Donald Kroeker, consulting engineer; John H. Bonebrake, of Mr. Kroeker's office; and James A. Melvin, chief operating engineer of the Oregonian Building.

The heat pump session will be supplemented by inspection trips to the country's two largest heat pump installations—in the Oregonian and Equitable buildings.

The technical program:

Monday, July 2, 9:30 a.m.

Aluminum Ceiling Panels for Heating and Cooling, by E. S. Howarth, chief, metal working division; S. C. Huddleston, research engineer, and R. M. Koch, research engineer, all of Research Laboratory, Aluminum Company of America, New Kensington, Pa.

Laboratory Studies of the Thermal Characteristics of Plaster Panels, by C. M. Humphreys, senior engineer; C. V. Franks, research fellow, and L. F. Schutrum, assistant research engineer, all of ASHVE Research Laboratory, Cleveland, O.

Optimum Panel Surface Distribution Determined from Human Shape Factors, by F. W. Hutchinson, professor of mechanical engineering, University of California, Berkeley, Calif., and Meri Baker, assistant professor of mechanical engineering, University of Kentucky, Lexington, Ky.

Barometric Draft Control Analysis, by H. B. Nottage, research associate; D. W. Locklin, research engineer; and R. G. Huebscher, research fellow, all of ASHVE Research Laboratory, Cleveland, O.

Tuesday, July 3, 9:30 a.m.

Control of Air Streams from a Long Slot, by Alfred Koestel, instructor in mechanical engineering, and Chia-Yung Young, graduate assistant in mechanical engineering, both of Case Institute of Technology, Cleveland, O.

Pressure Losses of Take-Offs for Extended-Plenum Duct Systems, by J. W. Holl, research assistant in mechanical engineering; S. F. Gilman, research assistant, professor of mechanical engineering; R. J. Martin, associate professor of mechanical engineering; and S. Konzo, professor of mechanical engineering, all of the University of Illinois, Urbana, Ill.

Warm Air Perimeter Heating—Heat Emitted from Floor Surface, by J. R. Jamieson, research associate in mechanical engineering; R. W. Roose, research assistant, professor of mechanical engineering; and S. Konzo, professor of mechanical engineering, all of the University of Illinois, Urbana, Ill.

Furnace Thermal Efficiency Determined from Flue and Jacket Loss, by H. L. McPherson, assistant chief standardization engineer; K. L. Badger, research engineer; and Walter S. Zawada, research engineer, all of the American Gas Association Laboratories, Cleveland, O.

Wednesday, July 4, 9:00 a.m.

Heat Pump Application to a Newspaper Plant, by J. D. Kroeker, consulting engineer; John H. Bonebrake, office of J. Donald Kroeker; and James A. Melvin, chief operating engineer, Oregonian Building, all of Portland, Ore.

Two-Year Performance of a Heat Pump System Furnishing Year-Round Air Conditioning in Modern Office Building, by Philip Sporn, president; and E. R. Ambrose, air conditioning engineer, both of the American Gas & Electric Service Corporation, New York, N. Y.

Climatology as an Aid in Heat Pump Design, by G. S. Smith, professor of electrical engineering, University of Washington, Seattle, Wash.

Heat Requirements of Buildings, by C. W. Signor, supervisor of customers' steam service, The Detroit Edison Company, Detroit, Mich.

• **SPECIAL EVENTS.** — Mr. Farnes pointed out that besides the special events which will include scenic tours to such spots in the surrounding countryside as Multnomah Falls, the Columbia River Gorge, Bonne-

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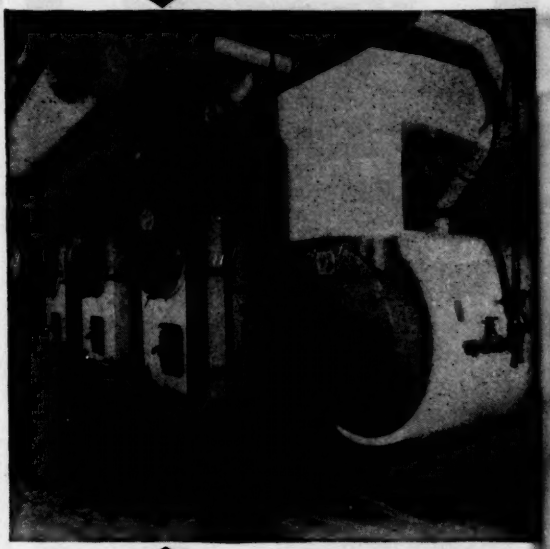

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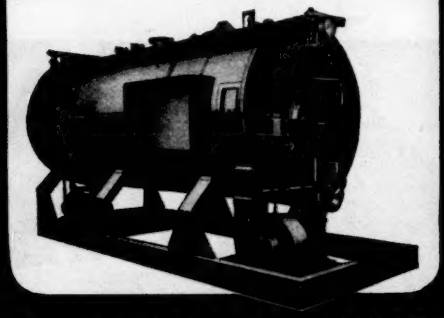

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NATURAL GAS

coming to 125 new cities. GAMA reports 7,618 miles added to pipelines.

Current construction of 7,618 miles of new natural-gas pipeline involving record expenditures of $630 million will bring new or additional benefits this year to millions of homes and thousands of industries in 125 cities of 50,000 or more population and in neighboring communities.

• **EXPANSION.**—In addition to construction now under way, as authorized in 1950 by the Federal Power Commission, the fourth annual pipeline survey of the Gas Appliance Manufacturers Association also revealed that major applications involving an additional 15,866 miles of pipeline, to cost an estimated $943,640,000, awaited hearing and disposition by the Commission on January 1, 1951. Latest expansion brings the pipeline aggregate to a total of 296,000 miles, including field and gathering lines, 69,000 more than the combined mileage of all U. S. railroads.

• **RESERVES.**—Despite a rapid rise in gas use by residential and industrial consumers during the past five years, new gas reserves each year have exceeded the annual rate of usage, he said. Current proven recoverable reserves, as estimated jointly by the American Gas Association and the American Petroleum Institute, the GAMA study reported, are at 185.6 trillion cubic feet—5.2 trillion over reserves of the preceding year—despite record consumption of natural gas during 1950.

• **DISTRIBUTION.**—The most significant occurrence in the industry last year, according to GAMA managing director, H. Leigh Whitelaw, was the introduction of natural gas to large population centers of the eastern seaboard. The GAMA director pointed out, however, that at the beginning of this year dockets pending before the Federal Power Commission were directed at practically all sections of the country.

For example, he said, the Northwest is the center of three projects, two of which call for the utilization of gas from Canadian fields; the third, involving 2,500 miles of pipeline from Texas at a cost of more than $174,000,000. The New England and Southeastern areas also are prominent in the projected natural-gas line of march, Whitelaw added.

• **TEXAS CORP.**—Texas Gas Transmission Corp. has asked the Federal Power Commission for a certificate authorizing construction of 614 miles of pipeline to provide an additional 200 million cu ft of natural gas daily to its midwestern markets and to Appalachian areas, where increasing industrial production is creating the need for more gas.

• **COST.**—In its application, the company estimated the cost of pipelines and stations at $46,600,000, and also

stated that first construction on the new facilities can start not later than 60 days after the commission authorizes the project, with the goal of making initial deliveries early in 1952.

Hearings before the FPC have not yet been scheduled.

Delivery capacity of the company's system would be increased to over 900 million cubic feet a day after the expansion program is completed.

• **NEED.**—The company told the commission in its application that industrial development of its service area is being accelerated, and that additional natural gas supplies are urgently required to meet the needs of plants and labor forces devoted to the production of military materiel.

In addition to supplying present customers, Texas Gas will be able to sell 95 million cubic feet of gas a day to The Ohio Fuel Gas Co., an operating subsidiary of the Columbia Gas System, serving communities throughout Ohio, including Columbus, Dayton, and Cincinnati.

• **PROPOSAL.**—Specifically, Texas Gas proposes to:

(1) Construct 425 miles of 26-inch loop line along its present system from Bastrop, Louisiana to Hardinsburg, Kentucky, including two lines under the Mississippi River.

(2) Build a 189-mile line linking new gas gathering subsidiaries in the Gulf Coast region of southwestern Louisiana with the company's main 26-inch line in the northeastern part of the state.

(3) Add 14,620 compressor horsepower, including a new 4,400 horsepower station near Madison, Indiana.

The company has made arrangements for the purchase of the major portion of steel pipe required for the expansion.

NPA

may amend basic construction order.

The National Production Authority, U. S. Department of Commerce, on May 3 told the Construction Industry Advisory Committee it is considering the issuance of an amendment to the basic construction order adding to the categories of construction for which NPA authorization is required.

The action, NPA said, will promote further conservation of steel and other construction materials in the interests of the defense program and will coordinate the requirements of the construction industry with NPA's Controlled Materials Plan.

Among major provisions expected to be in the amendment, NPA said, are these:

(1) It would require NPA authorization for construction of large apartment houses, luxury residences, and certain industrial facilities.

(2) It would make allowance for certain "personal property" equipment installations up to a fixed amount.

(3) It would change the definition of when construction is "commenced."

• **DEFINITION.**—In the amended order, "commence construction" is expected to be defined to mean "sub-

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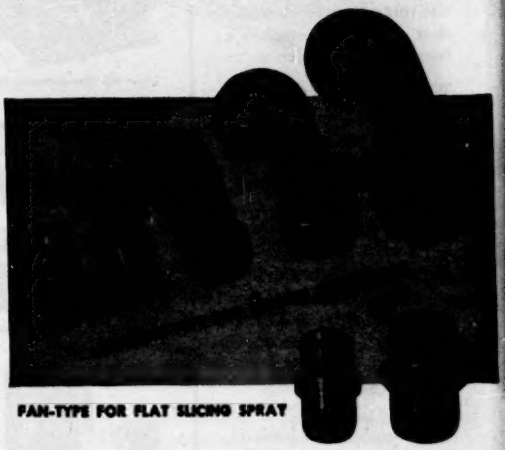

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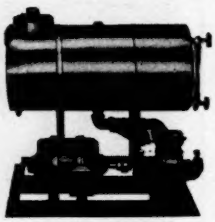
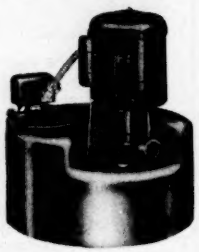


Type TM Turbine Pump



Type CV Vertical Pump

SKIDMORE PUMPS

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stantial site clearance (including demolition of buildings or structures), preliminary to the start of or incident to work on a new building, structure or project; or to incorporate into a building, structure or project substantial quantities of materials which are to be an integral and permanent part of such building, structure or project."

The significance of this change in definition would be considerable, NPA said, since "commence construcion" was previously defined as meaning to incorporate into a building, structure or project a substantial quantity of materials which are to be an integral and permanent part of such building, structure or project (for example, the pouring or placing of footings or other foundations).

After hearing a discussion of the theory and operations of the Controlled Materials Plan, which goes into effect July 1, the committee unanimously asked for inclusion of the construction industry under CMP, provided that claimant agencies are set up for construction requirements.

NEW BOILER DESIGNS

meet fuel changes and costs.

Present-day changes in quality, price and availability of fuels call for new designs in boilers and fuel burning equipment, P. R. Loughin, chief staff engineer of The Babcock & Wilcox Company, said at the Atlanta meeting of ASME, April 4.

• **AVAILABILITY.**—Mr. Loughin said that up until several years ago the designs for power plant equipment could be based on specified fuels for a given locality, but recent developments have made it necessary to provide "boilers and fuel burning equipment to accommodate a greater diversity of fuels and fuel quality."

"There has been a general lowering of quality of raw coal in recent years, along with an increase in cost," he said. At present the United States is producing petroleum at an over-all rate approximately equal to the demand, he said, but the production of heavy fuel oils has been only 85 to 88% of the demand, resulting in increased consumption of imported heavy oils. Because of the blending done in refineries and in distribution, it is not often possible to count on receiving a given quality of oil over an extended period, he added.

"The rapid expansion and use of pipe line transportation of natural gas has made this fuel available at attractive rates in many localities but in many cases its availability for power boilers is seasonal," he pointed out.

• **COSTS.**—Changing fuel costs, influenced by supply and demand and wartime restrictions, have increased the importance of diversification. The increased cost of fuel and labor has created the need for efficient utilization of various fuels which in the past were considered by-products or waste, such as bagasse—the fibrous residue from sugar cane, utilized for fuel by sugar mills; and the waste liquor from sulfite wood

pulping plants, from which both heat and chemicals are recovered.

• **CHARACTERISTICS.**—Sulphur, moisture and ash contents of the fuel, and ash fusion temperatures are the most important relevant fuel characteristics, he said.

Moisture is an important factor in the design of equipment for it affects storage, handling, ignition, furnace temperatures, corrosion, and efficiency.

Ash fusing temperatures vary considerably with the atmospheric conditions under which they exist, he explained. "Most coal ashes have been found to have higher fusing temperatures in oxidizing than in reducing atmospheres," he said. "The spread depends primarily on the quantity of iron in the ash. Many oil ashes react oppositely. The fusing temperatures are lower in an oxidizing atmosphere than in a reducing atmosphere. This is particularly true of oils having relatively high vanadium content.

"The designer should have specified and reliable information on the properties and quantity of the ash in the fuels to be burned in order to properly select burning equipment and proportion the furnace."

• **PROVISION IN DESIGN.**—Refractories, and metals at elevated temperatures, are subject to attack by ash. Sulphur in a fuel plays an important role in the low temperature level corrosion and surface fouling problems. Ash and sulphur contents of a fuel affect heat absorbing surface fouling and ash disposal.

Boilers designed to handle different types of fuels require that proper provisions be made in the design stage. Efficiency will be affected by the constituents of the fuels. Variations in hydrogen content cause a considerable change. Unburned combustible losses are an important factor that must be considered. Furnace absorption varies with the types of fuels as well as the excess quantity of air required for optimum combustion, both of which have a direct bearing on superheater absorption; hence, steam temperature variations. The effect of fuels and load cycles on furnace and heating surface fouling must also be considered, Mr. Loughin said.

• • •

• The 37 states east of the Rocky Mountains showed an increase of 8% in construction contracts awarded in April over March, and a gain of 2% over April 1950, it was announced by F. W. Dodge Corp. The construction award total for the first four months of 1951 was $4,826,216,000, 16% higher than the corresponding total for 1950. Four-month totals 1951, showed nonresidential building 30% ahead of the similar period 1950. Residential awards were 8% greater than last year; and public and private works and utilities were 10% more than the corresponding total for 1950.

• The election of six life members of ASHVE has been announced. The leaders in the field of heating, ventilating and air conditioning thus honored are: Gustav A. Dornheim, New York, N. Y.; Byron K. Eaton, Hinsdale, Ill.; Coll Turner Flint, Boston, Mass.; J. Ambler Johnston, Richmond, Va.; Van Applegate Reed, Jr., Pittsburgh, Pa., and Carl Edward Zibold, White Plains, N. Y.

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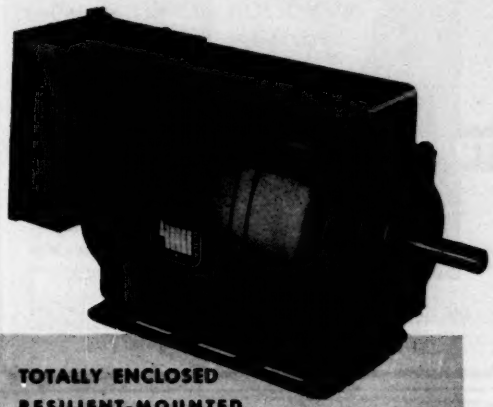
for fan, blower and unit heater applications



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. . . quiet, vibrationless operation. Resilient Gimbal-mounted. Rubber-mounted knock-out box, insulated from motor frame, prevents transmission of noise and vibration.

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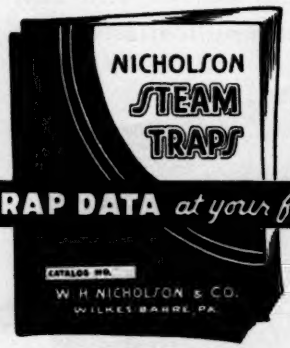

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CORRECTION NOTICE

In the abstract "Flow Characteristics of Air Outlets" in the May issue, two errors occurred in formulas. The formula for pressure drop across a grille face should be

$$P = \left(\frac{V}{4{,}005}\right)^2$$

where P is pressure drop in inches of water and V is the face velocity in feet per minute. The formula for throw of air from narrow slots should be

$$V_r = 2V_o \frac{\sqrt{h}}{l}$$

where V_r is residual velocity in feet per minute at the distance, l, from the opening; V_o is outlet velocity in feet per minute; h is height of slot in inches. It should be pointed out, also, that the author of the original British paper, A. W. Evans, based his presentation largely on American and Swedish research by Tuve, Preister, Wright, Koestel, Rydberg, Norback and others credited in a bibliography appended to the original; the paper was not based entirely on research in England as implied in the abstract.

HEAT PUMP DESIGN PROBLEMS

(Concluded from page 88)

pumps must plan to use single-phase power. Where 3- and single-phase power is available, the convenient and efficient compressor capacity modulation makes possible the 2-speed 3-phase motor.

Frequent starting of 3 or 5 hp motors, particularly single-phase motors, will cause large in-rush current which will have to be considered in sizing the distribution lines. Thus, widespread use of the heat pump will call for current limitations on the part of the public utilities. Control equipment for reduced voltage starting or sequence starting of multiple compressors will be required.

Efficiency of the motor itself is an important factor in heat pump applications. For example, the typical 3 hp installation may require about 96 million Btu during the heating session. With the performance factor 3.0, the unit will use at least 9,400 kwh per year for heating, plus whatever is needed for cooling. If the over-all demand is 11,500 kwh per year at a cost of 2 cents per kwh, the yearly power bill is $230. A 1% increase in efficiency in the motor or compressor would save about $2.30 a year. If the first cost of a motor can be amortized over five years, a 1% increase in efficiency is worth $11.50. An increase of 5% with the same assumed values would be worth over $55 in extra motor cost. The same consideration applies to the compressor.

Compressor modulation carries with it another problem in motor loading. The power input curve in Fig. 1 should be at a maximum where the heat required is a maximum, preferably at the rating point for maximum utilization. The unmodulated compressor has a peak motor loading of 128% with the loading at the design point and the motor must be loaded at the rating point to allow for expected peak. Thus, step modulation of the compressor results in more efficient motorizing, since it can raise the ratio of electrical demand at maximum heat required to actual maximum from 78% to 95%.

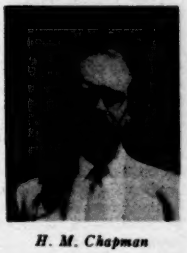
Packaged units, with the refrigerant system in one conveniently manufactured bundle, offer some advantages that will help to outweigh the difficulties in air-to-air heat pump design. Further research or invention on the interesting problem of the thermal flywheel will also assist the air-to-air system. Motor designers and refrigerant compressor designers have opportunity to use their best talents toward high efficiency units, while control designers have plenty of room for invention of circuits to make best use of equipment under conflicting requirements.

Getting Personal

A. E. Hunter

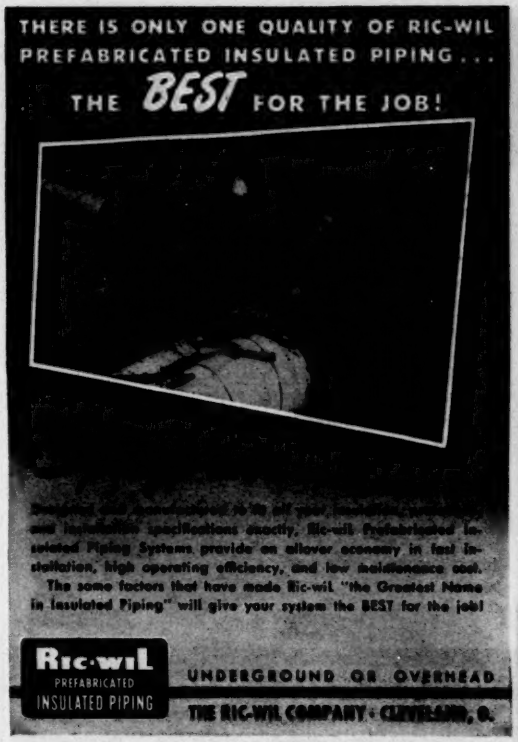
Alex E. Hunter *(Steam Requirements of Commercial Laundries*, page 67), in 1924 received a Bachelor of Science degree in mechanical engineering from The Pennsylvania State College. With the exception of two years, when he was employed by a Pacific Coast lumber company, he has spent his entire working career with the Duquesne Light Co., Pittsburgh, Pa. For the past 20 years he has been providing engineering counsel on power, heating, air conditioning, refrigeration and allied problems as a free service that is offered to commercial customers by his employer.

Mr. Hunter is a licensed professional engineer and is a member of the Engineers Society of Western Pennsylvania.



H. M. Chapman

Harlow M. Chapman *(Relation of Fan Characteristics to Common Ventilation Problems*, page 71), received a B.S. in chemical engineering in 1938 at Alabama Polytechnic Institute, Auburn, Alabama. He was an industrial hygiene engineer for Liberty Mutual Insurance Company, and then during the war spent 3½ years as industrial hygiene engineer at the Army Industrial Hygiene Laboratory, Johns Hopkins School of Public Health, Baltimore, Maryland, where most of his time was spent in the ventilation section. After the war he spent a short period in the engineering department of the Buffalo Forge Co., Buffalo, New York, working on industrial ventilation problems, and then went to Mellon Institute of Industrial Research in Pittsburgh. At that time he was a chemical engineer for the Industrial Hygiene Foundation concerned with problems of industrial hygiene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and air pollution. He is now engaged as industrial hygiene engineer for the Bethlehem Steel Co., where his time is devoted to studies of air pollution. He is a professional chemical engineer in the Commonwealth of Pennsylvania, and, at present, secretary of the Philadelphia Section of the American Industrial Hygiene Association.

George Nafe (*Selection of Induction Motors for Air Conditioning, Heating and Ventilating Equipment*, page 75), at present manager of the Sales Service Section, Century Electric Co., St. Louis, Mo., received his B.S. degree from the University of Kansas in 1941. Following graduation he was employed by Century Electric as a sales engineer in Davenport, Ia., Rochester and Buffalo, N. Y. In April, 1950, he was transferred to the company's home office in St. Louis and advanced to his present position. His work consists of handling engineering and production problems relating to sales and customer service.

Mr. Nafe is a member of the American Ordnance Association and an associate member of the American Society of Refrigeration Engineers.

INDUSTRIAL DEGREE-DAYS
April, 1951

City	55F Base	45F Base
Baltimore, Md.	65	0
Buffalo, N. Y.	304	87
Chicago, Ill.	279	72
Cleveland, Ohio	540	282
Detroit, Mich.	287	67
Indianapolis, Ind.	259	65
New York, N. Y.	117	6
Philadelphia, Pa.	80	1
Pittsburgh, Pa.	191	34
St. Louis, Mo.	178	38

Canadian Degree-Days for April, 1951*

City	April		Cumulative Sept. 1 to Apr. 30	
	1951	Normal	1950-51	Normal
Calgary, Alta.	834	750	9684	8631
Charlottetown, P.E.I.	696	858	6848	7727
Crescent Valley, B. C.	630	624	7176	7328
Edmonton, Alta.	833	780	10375	9369
Fort William, Ont.	870	888	9848	9478
Grande Prairie, Alta.	876	822	11259	9617
Halifax, N. S.	641	768	5865	6902
London, Ont.	630	642	6911	6968
Medicine Hat, Alta.	741	606	9260	8194
Moncton, N. B.	731	798	7192	8094
Montreal, P. Q.	624	715	7469	8088
North Bay, Ont.	756	813	8790	8746
Ottawa, Ont.	644	726	7849	8364
Penticton, B. C.	543	507	6134	6073
Porquis Junction, Ont.	798	972	10153	10586
Prince George, B. C.	756	738	9502	8506
Quebec City, P. Q.	726	849	7873	8848
Regina, Sask.	951	816	11226	10891
St. John, N. B.	654	792	6634	7576
Saskatoon, Sask.	894	725	11405	10081
Toronto, Ont.	598	669	6184	6895
Vancouver, B. C.	483	498	5055	4977
Victoria, B. C.	457	504	4763	4569
Windsor, Ont.	588	582	6350	6454
Winnipeg, Man.	853	822	10406	10444

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

ASME MEETING—Semi-annual meeting of the American Society of Mechanical Engineers, at Hotel Royal York, Toronto, Ont., Canada. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y. .....**JUNE 11-15, 1951.**

TESTING MATERIALS MEETING — Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. .....**JUNE 18-22, 1951.**

STOKER MEETING — 1951 annual meeting of the Stoker Manufacturers Association, at South Shore Inn, Lake Wawasee, Syracuse, Ind. Marc G. Bluth, executive secretary of the Association, 307 North Michigan Avenue, Chicago 1, Illinois. .....**JUNE 25-26, 1951.**

ELECTRICAL ENGINEERS MEETING—Summer general meeting of the American Institute of Electrical Engineers, at Royal York Hotel, Toronto, Ont., Canada. Secretary of the Institute, 33 West 39th St., New York 18, N. Y. .....**JUNE 25-29, 1951.**

ASHVE MEETING—Semi-annual meeting of the American Society of Heating and Ventilating Engineers, at the Hotel Multnomah, Portland, Ore. A. V. Hutchinson, executive secretary of the Society, 51 Madison Ave., New York 10, N. Y. .....**JULY 2-4, 1951.**

REFRIGERATION CONGRESS—Eighth International Congress of Refrigeration, under the auspices of The International Institute of Refrigeration, to be held at Church House, Westminster, London, England. The Secretary, Dalmeny House, Monument St., London, E. C. 3. .....**AUGUST 29—SEPTEMBER 11, 1951.**

ENGINEERING EXHIBITION—The Engineering, Marine and Welding Exhibition, sponsored chiefly by The British Engineers' Association, Inc., to be held in London, England. A. W. Berry, director of the Association, 32 Victoria St., London, S.W. 1. .....**AUGUST 30—SEPTEMBER 13, 1951.**

INSTRUMENT CONFERENCE AND EXHIBIT—1951 Instrument conference and national exhibit of the Instrument Society of America, at the Coliseum, Houston, Tex. John McCaffery, assistant executive secretary of the Society, 921 Ridge Ave., Pittsburgh 12, Pa. .....**SEPTEMBER 10-14, 1951.**

ASME MEETING—Fall meeting of the American Society of Mechanical Engineers, at the Radisson Hotel, Minneapolis, Minn. C. E. Davies, secretary of the Society, 29 West 39th St., New York 18, N. Y. .....**SEPTEMBER 25-28, 1951.**

PLUMBING AND HEATING MEETING—Annual meeting of the Plumbing and Heating Industries Bureau, at Palmer House, Chicago, Ill. Norman J. Radder, secretary of the Bureau, 35 East Wacker Drive, Chicago 1, Ill. .....**OCTOBER 11, 1951.**

AGA CONVENTION—33rd annual convention of the American Gas Association, at Kiel Auditorium, St. Louis, Mo. Secretary of the Association, 420 Lexington Avenue, New York 17, N. Y. .....**OCTOBER 15-17, 1951.**

PUBLIC HEALTH MEETING — 79th annual meeting of the American Public Health Association, at Civic Auditorium, San Francisco, Calif. Willimina Rayne Walsh, associate secretary of the Association, 1790 Broadway, New York 19, N. Y. .....**OCTOBER 29—NOVEMBER 2, 1951.**

REFRIGERATION SHOW—7th All-Industry Refrigeration and Air Conditioning Exposition, at Navy Pier, Chicago, Ill. Show director, REMA 1346 Connecticut Ave., N.W., Washington, D. C. .....**NOVEMBER 5-8, 1951.**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, at Chalfonte-Haddon Hall, Atlantic City, N. J. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y. .....**NOVEMBER 25-30, 1951.**

HEATING WHOLESALERS' MEETING—Annual meeting of the National Heating Wholesalers' Association, at the Hotel Statler, Cleveland, Ohio. E. L. Wyman, executive secretary, 609 Commerce Building, Cleveland. .....**DECEMBER 3-4, 1951.**

WARM AIR CONVENTION—38th annual convention of the National Warm Air Heating and Air Conditioning Association, at Hotel Cleveland, Cleveland, Ohio. George Boeddener, managing director, 145 Public Square, Cleveland. .....**DECEMBER 5-6, 1951.**

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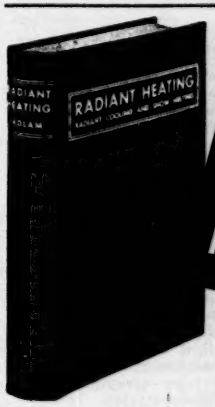

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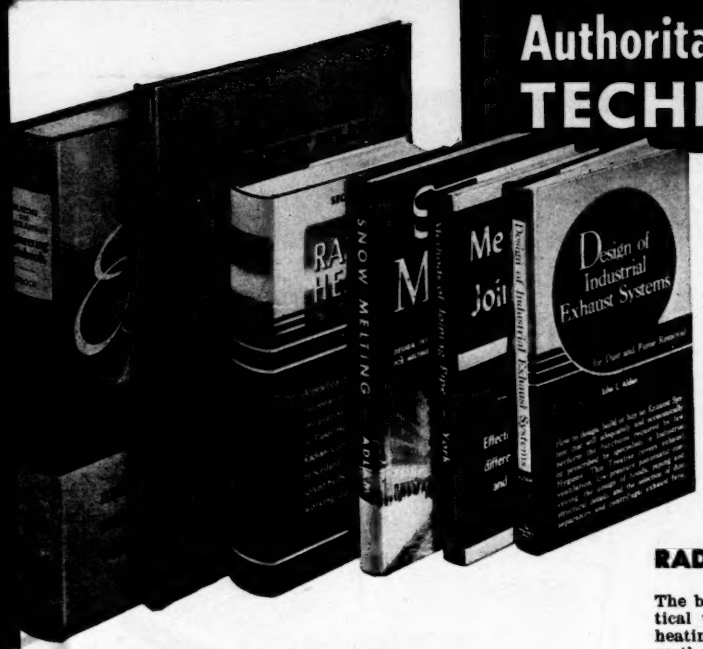

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Here's why..

Note that the valve disc is opened* by the expanded thermostat. This allows a BTU LIQUID (temperature) discharge* at a greater BTU capacity than the firing means can generate. The sensitive thermostat responds to excessive temperature conditions. It expands* to open the valve when the water is too hot, and contracts to self-close the valve after the tank water is cooled to a safe temperature, as if hot water were being drawn.

When superheated water is confined in a tank it cannot explode, but, nevertheless, all of the latent heat energy is there LURKING. But - - - if the tank should rupture, as many do, because of heat weakening, physical deterioration from water conditions or structural weakening, an explosive disaster can result. Likewise, a stick of dynamite will not explode if the fuse isn't ignited, but the explosive power is still in it. Therefore, you can be sure that a domestic hot water tank or heater is safe when a reliable temperature and pressure relief valve removes the explosive force above 212°.

WATTS REGULATOR COMPANY, LAWRENCE, MASSACHUSETTS

AIR CONDITIONING DESIGN CONDITIONS — COMMERCIAL BUILDINGS

(Compiled from last monthly Reference Data)

Restaurants

Three areas must be considered in air conditioning restaurants—the dining room proper, the space reserved for the bar, and the kitchen.

In the dining areas, conditions are held at 78F and 50% R.H. Cafeterias, which have the problem of the open steam tables, maintain temperatures one or two degrees lower than those followed in conventional dining areas. On warm days, an attempt is made to maintain a differential of 12 to 14F between inside and outside conditions. It is important that a positive pressure be created as compared with the kitchen in order to prevent kitchen air and odors from entering the dining areas.

Because of the higher metabolic rate of persons drinking at the bar, as compared with those dining in the restaurant, it is necessary to supply a greater amount of cool air to create the necessary coolness.

One large restaurant chain keeps its kitchens at 76 to 80F with a relative humidity of 55%. The summer condition is 80F. It is rather expensive to air condition kitchens because of the large heat gain produced in cooking; therefore, air-cooled kitchens are not too common. From the cost standpoint, it is advantageous when establishing design conditions to figure on temperatures in the kitchen being 5F higher than those in the dining areas. However, the dew point in both places is the same. This slightly raises the wet bulb temperature in the kitchen over that in the restaurant.

Retail Food Stores

Government statistics show that there are more than 500,000 establishments in the United States that handle food. While very few of this number are air conditioned or even ventilated, it has been proven that besides comfortable conditions for employees and customers, air conditioning has improved the keeping qualities of the food being sold.

Cooling can be accomplished by ventilation with large quantities of outside air, evaporative cooling, and by mechanical cooling. Climatic conditions in the area where the store is located will determine which of these three methods will prove the most satisfactory. For design conditions, three climatic zones can be established, each suitable for one of these methods of cooling.

Ventilation Zone—This covers areas of outside design dry bulb temperatures of 85F and lower.

Evaporative Cooling Zone—This should have low outside design wet bulb temperatures from 68 to 70F and outside design dry bulb temperatures from 96 to 110F. It is preferable to have a differential between wet and dry bulb of 26F or more.

Mechanical Cooling Zone—This includes areas of high outside wet bulb temperatures of 76 to 80F and outside design dry bulb temperatures of 90 to 110F.

There is a gap in these zones between 85 and 90F design dry bulb temperatures where ventilation is ordinarily not satisfactory and it is difficult to justify mechanical cooling.

Where stores are mechanically air conditioned, inside conditions are held at 80F dry bulb and about 50% R.H. The differential between inside and outside temperatures is from 15 to 20F.

Television Studios

It is considered good practice in the air conditioning of television studios to have a maximum inside-outside temperature differential of 20F. The chief problem is to provide conditions that would not endanger the health of the performers because of wide variations in ambient temperatures.

In general, winter air conditions should be 70F and 45 to 50% R.H., with maximum summer conditions of 80F and 50 to 60% R.H., depending on outside temperature and wet bulb reading.

Women's Specialty Stores

In a women's specialty store, air conditioning pays in personal comfort for customer and employee, and in large monetary savings for the management by preventing perspiration damage to the dresses and wearing apparel. It is most important that conditions be established for "drying out" the customer before she tries on a dress, and experience has shown that the time spent in selecting a dress in an air-conditioned atmosphere provides a sufficient cooling-off period, before the dress is tried on.

The selling area is maintained at 78F and 50% R.H. during the summer; for the winter months, temperature is 74F with little attention paid to humidity.

Since customers spend more time in the fitting rooms than in any other part of the store, a large part of the sales is made in the fitting area. Because the fitting section is small in cubical volume, and has a greater occupancy concentration than any other part of the store, it presents a serious air conditioning problem. This area, as compared with the main part of the store, requires a slightly higher temperature during the summer period, and also during the heating season. There should be a 2 to 3F temperature differential between fitting and general sales areas. Sufficient outside air must be circulated to prevent odors. Exhaust air from the fitting room should be discharged, and never recirculated.

AIR CONDITIONING DESIGN CONDITIONS – COMMERCIAL BUILDINGS

Commercial Applications

While this article covers a number of special commercial applications, it is safe to group the others not specifically mentioned under this general heading. The various trade unions are credited with forcing the general use of air conditioning in a number of commercial fields.

At one time there was a tendency to design all commercial air conditioning installations for 80F and 50% R.H., and to assume design conditions for southeast and southwest locations at 78F and 60% R.H. The present practice is to drop the temperature to 78F.

Where the system is located in a wide dust area, with dust being liberated by some nearby industry or present from other causes, special treatment for dust removal may be indicated. Although electrostatic filters have proven satisfactory for such special treatment, most of the filters now being used are of the throwaway type.

Another authority gives the following generalized inside conditions: where occupancy is less than 1 hour, 82F D.B., 69F W.B.; same but where cost is a consideration and partial cooling is acceptable on hot days, 80F D.B. and 68F W.B.; where occupancy is over 1 hour, 78F D.B., 67F W.B.

In Table 2 are listed recommended summer inside design conditions for many geographical sections and for various dry and wet bulb conditions for specific ET or effective temperature values. It also gives data for continuous and transient occupancy. The latter is defined as occupancy of less than one-half hour.

TABLE 2—RECOMMENDED SUMMER INSIDE DESIGN CONDITIONS
(Data by Carrier Corporation; reproduced by permission)

Location—General Description	Typical Outdoor Design Conditions, Deg F		Continuous Occupancy								Transient Occupancy			
			Optimum Conditions				Commercial Maximum Conditions				Commercial Maximum Conditions			
	Dry Bulb	Wet Bulb	ET	DB Deg F	WB Deg F	RH %	ET	DB Deg F	WB Deg F	RH %	ET	DB Deg F	WB Deg F	RH %
Northern United States at Sea Level	93	75	70	77	59.7	35	73	81	62.7	35	74	82	65.1	40
				76	60.5	40		80	65.2	45		81	66.0	45
				75	62.7	50		79	66.0	50		80	66.7	50
				74	64.4	60		78	66.5	55		79	68.8	60
Central United States at Sea Level	95	78	71	78	62.0	40	74	82	65.1	40	75	83	65.9	40
				77	62.8	45		81	66.0	45		82	66.8	45
				76	64.9	55		80	66.7	50		81	69.1	55
				75	65.3	60		79	68.8	60		80	69.7	60
Southern United States Coastal Region at Sea Level	95	80	72	79	62.8	40	75	83	65.9	40	76	85	67.4	40
				78	63.5	45		82	66.8	45		84	68.3	45
				77	65.7	55		81	69.1	55		83	69.2	50
				76	66.2	60		80	69.7	60		82	69.8	55
North Pacific Coast, United States, at Sea Level	85	65	68	74	59.0	40	70	77	59.7	35	71	78	62.0	40
				73	59.6	45		76	60.5	40		77	62.8	45
				72	61.4	55		75	62.7	50		76	64.9	55
				71	61.8	60		74	64.4	60		75	65.3	60
South Pacific Coast, United States, at Sea Level	90	70	69	76	57.3	30	71	78	62.0	40	72	79	62.8	40
				75	59.7	40		77	62.8	45		78	63.5	45
				74	61.8	50		76	64.9	55		77	65.7	55
				73	63.4	60		75	65.3	60		76	66.2	60
Desert Region at Sea Level	110	75	72	79	62.8	40	75	83	65.9	40	76	85	67.4	40
				78	63.5	45		82	66.8	45		84	68.3	45
				77	65.7	55		81	69.1	55		83	69.2	50
				76	66.2	60		80	69.7	60		82	69.8	55
Mountain 3,000 to 7,000 Ft Elevation	95	70	69	76	57.3	30	72	79	62.8	40	73	81	62.7	35
				75	59.7	40		78	63.5	45		80	65.2	45
				74	60.4	45		77	65.7	55		79	65.8	50
				73	62.3	55		76	66.2	60		78	66.5	55
Tropical, Subtropical and Equatorial at Sea Level	90 to 100	80	72	79	62.8	40	75	83	65.9	40	76	85	67.4	40
				78	63.5	45		82	66.8	45		84	68.3	45
				77	65.7	55		81	69.1	55		83	69.2	50
				76	66.2	60		80	69.7	60		82	69.8	55

CLARAGE HEAVY-DUTY FANS

HELP PROTECT FOR POSTERITY

WORLD'S LARGEST MASTERPIECE OF HOLY ART

. . . . in the Hall of the Crucifixion, Forest Lawn Memorial-Park, Glendale, California

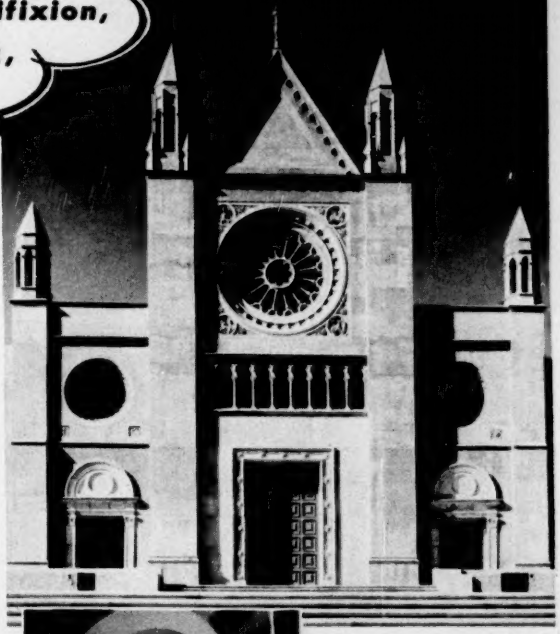
Completed in 1895, Poland's great artist, Jan Styka spent 17 years painting the Crucifixion. A city block long, four stories high (195' by 45') — it contains 1,182 human figures.

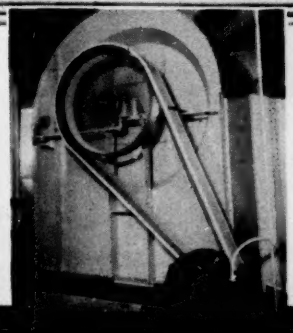
After 50 years in obscurity, this holy art now hangs in the new Hall of the Crucifixion — in the famous Forest Lawn Memorial-Park.

Dedicated this year on Good Friday, the Hall is an auditorium-type structure built to house the picture and permit 2,000 people to view it.

To provide human comfort and to guard the fabulous canvas from deterioration is the two-fold responsibility of the auditorium's complete air conditioning system.

Here, as on so many other important conditioning jobs, **no mistake was made by installing Clarage HEAVY-DUTY fan equipment.**





ARCHITECTS:
Architectural Department of Forest Lawn Memorial-Park

ENGINEERS:
Stockley and Bamford, Los Angeles

CONTRACTOR:
F. B. Gardner Co., Los Angeles

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

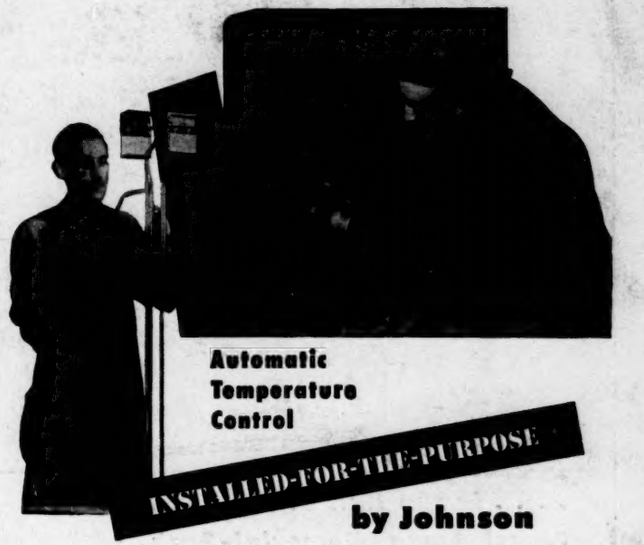
JOHNSON CONTROL In FINE BUILDINGS EVERYWHERE

• **General Service Building, University of Michigan, Ann Arbor, Michigan:** Both economy and comfort are assured by 588 Johnson *Dual* Thermostats, providing individual room control. Johnson *Dual* Control maintains proper temperatures in occupied rooms and, at the same time, insures reduced economy temperatures in all areas which are not in use.

• **100 Park Avenue, New York City:** More than a thousand Johnson *Heating-Cooling* Thermostats control over three thousand Johnson Valves in the air conditioning units in this modern office building — one of New York's finest.

• **Roosevelt Hotel, New Orleans, La.—** A Johnson Selective Room Thermostat permits the guests in each of this hotel's 900 rooms to choose any temperature between 65° and 78°. A Johnson Mixing Damper admits air, at exactly the right temperature, from double ducts above the corridor ceilings.

• **The Shamrock Hotel, Houston, Texas:** More than 900 Johnson Room Thermostats enable the occupants of each room of this four-square-block hotel to select any temperature between 68 and 80 degrees. Johnson Outdoor Master Controls regulate the temperature of the primary air which is supplied to the unit air conditioners throughout the building.



Going even further than manufacturing automatic temperature control equipment and planning each system for the exact purpose which it is to serve! Those activities are only two-thirds of the complete Johnson chain of responsibility. The final step is the *installation* of the apparatus, which also is done by members of the nation-wide Johnson organization. Installed-for-the-purpose, to fit each particular job!

A unique corps of Johnson mechanics does the installation work. The members of this distinctive group are stationed at strategic locations in each of the company-owned branch office territories, to carry out the instructions of the Johnson staff of branch managers and field engineers. Johnson mechanics are Johnson's own men, devoting their entire time to the specialized work which they have been trained to perform. They are temperature control craftsmen, with a practical background in the pipe-fitting trade.

To serve the best interests of users of Johnson automatic temperature control systems is the objective which is attained by the policy of a complete "chain of responsibility." Manufacturing—planning—installing! Undivided interest, from start to finish, is centered in one highly-specialized organization. And yet, there is full cooperation with consulting engineers who are retained by owners or their architects and with their heating and air conditioning contractors... Ask a nearby Johnson engineer for recommendations which will solve *your* temperature control problems. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

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